THE UNIVERSITY OF ALBERTA

PICTORIAL INSTRUCTION OF STUDENTS WITH SEVERE HANDICAPS

BY

© NANCY YIN PING FOK

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Date...May..27..1985..

DEDICATION

To all my students
who have provided me with the motivation
to learn and to search

ABSTRACT

The present study investigated how pictures could be used to facilitate discrimination learning and to enhance generalization in pictorial instruction of students with severe handicaps.

In concept acquisition, a severely handicapped person must learn to attend to the relevant dimension of a concept and select the correct cue of that dimension to identify the discriminative features and distinguish them from the nondiscriminative features of the concept. Increasing the salience of discriminative features and reducing the number of nondiscriminative features in initial instruction directs a learner's attention to the discriminative features and reduces distraction of the nondiscriminative features of the concept being taught.

When color and background are nondiscriminative features of the concept, their inclusion in pictures that are used to teach concrete concepts to handicapped learners may impede the rate of concept acquisition. When these nondiscrimminative features are controlled, for example, with the use of black and white pictures without background during initial instruction, the rate of concept acquisition may be enhanced. However, generalization of learning may be reduced when the use of "simplified" pictures such as black and white photographs in the acquisition phase do not resemble life-like representations of the concept. The

learner may fail to generalize that the picture represents various different exemplars of the concept in the natural environment. If following initial instruction, there is a systematic and gradual introduction of nondiscriminative features (e.g. color and background), then the learner may initially acquire the concept faster without distraction and also learn to generalize as the nondiscriminative features are introduced.

The purpose of this study is to investigate the effect of three experimental conditions: a) black and white photographs without background; b) color photographs with full background (i.e. nondiscriminative features) and c) a fade-in color and background condition in which the color and background are gradually faded in to the black and white photographs following initial instruction. The effects upon the rate of concept acquisition, generalization and maintenance were examined.

Experimental subjects included three severely mentally handicapped boys (mean age 8.3 years; IQ approximately 30 or less). Each subject was taught three sets of three photographed objects (a blender, a reel, a light; an iron, a sander, a grinder; a spray can, a watering can, and a mixer) under three experimental conditions. The subjects were taught to trace the predetermined discriminative feature of each object as a correct response for identification. This study employed a single-subject,

multielement research design in which the order of the three experimental conditions to be taught were randomized and counterbalanced so that each condition is followed equally often by every other condition.

The results indicated that training under the black and white photographs without background required significantly less trials to criterion than the other two conditions. This showed that controlling the nondiscriminative features of the photographed objects, as in the black and white photographs without background, enhanced the rate of concept acquisition. The generalization and maintenance results showed no significant difference among the three conditions. However, all three subjects showed various degrees of generalization from photographs to real objects, regardless of the experimental conditions. By tracing the discrimfnative features of the photographed objects, the subjects might learn to generalize the discriminative features to that of the real objects. The generalization results proved that highly representative black and white photographs are viable alternative to using real objects for concept learning. Educational implications and future research in the area of pictorial instruction of students with severe handicaps were discussed.

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TABLE OF CONTENTS

Chapter — Page

I. INTRODUCTION 1

II. LITERATURE REVIEW 4

Pictures as Instructional Aids to Concept Learning 4

Pictures versus real objects in concept learning 4

The relative effectiveness of color or black and white pictures 8

Abstractness, complexity and background of pictures 13

Processes of Concept Learning 16

Discrimination learning 20

Discriminative features and nondiscriminative features of stimuli ..29

Color functions as a discriminative or nondiscriminative feature 33

Generalization 35

An overview 36

Various instructional components that affect stilmulus generlization 38

Strategies to facilitate generalization 41

Methods used to achieve generalization in the present study.....42

Maintenance 46

Errorless Learning 47

Prompting procedure 49

Verbal prompts 49

Modeling 49
Gestural prompts 50
Physical prompts 50
Fading procedures 53
Differential reinforcement 56
Edible reinforcers 58
Social reinforcers 60
Correction procedure 63
Single-subject Research Design 64
III.STATEMENT OF THE PROBLEM 72
Problem 72
Acquisition 75
Research Question Ia.....75
Hypothesis Ia 75
Rationale 75
Research Question Ib 75
Hypothesis Ib 75
Rationale 75
Research Question Ic 75
Hypothesis Ic 76
Rationale 76
Generalization 76
Research Question II 76
Hypothesis II 76
Rationale 77
Research Question on Maintenance 77

IV. METHOD 78

Subjects 78

Setting 79

Materials 80

Photographs 80

Object selection 81

Choice of discriminative feature 83

Tracing of discriminative features 84

Pretests 86

Pretest 1 86

Pretest 2 87

Pretest 3 87

Pretest 4 89

Experimental Design 90

Experimental conditions 90

Assignment of objects into three experimental conditions 94

Experimental procedure 96

Data collection 96

Reinforcement procedure 98

Correction procedure 99

Training Procedures for:

Object 1 99

Object 2 103

Object 3 105

Generalization tests 106

Maintenance test 108

V. RESULTS 109
Data evaluation 109
Acquisition 110
Hypothesis Ia 112
Hypothesis Ib 115
Hypothesis Ic 116
Summary 117
Generalization 117
Hypothesis II 119
Maintenance 125
Other Analyses 127
Individual object difficulty 127
Difficulty of group of objects 129
The effect of the order of teaching ...131
Multiple Regression Analysis 133
VI. DISCUSSION 135
Acquisition 135
Generalization 135
Photographs 137
Differences in difficulty of learning among objects 138
The order effect of teaching the objects..139
Educational implications 140
Further research 142
REFERENCES 144

LIST OF TABLES

Table	Description	Page
1	Objects that were taught to the 3 subjects under the 3 conditions.....	95
2	Total number of trials to criterion for each subject under the 3 conditions.....	113
3	Total number of correct responses of the 3 subjects in 4 generalization tests under the 3 conditions.....	120
4	Generalization results for subject 1: Number of correct responses in 4 generalization tests for the 3 conditions.....	121
5	Generalization results for subject 2: Number of correct responses in 4 generalization tests for the 3 conditions.....	122
6	Generalization results for subject 3: Number of correct responses in 4 generalization tests for the 3 conditions.....	123
7	Maintenance results: Number of correct responses of the 3 subjects in the maintenance test under the 3 conditions.....	126
8	Total number of trials to criterion required by the 3 subjects to learn the 9 objects.....	128
9	Total number of trials to criterion required by each subject to learn 3 groups of different objects regardless of conditions.....	130
10	Total number of trials to criterion required by each subject according to the order of teaching (i.e. 1st, 2nd, 3rd order of objects taught) regardless of conditions.....	132
11	Correlations between number of trials and each of the four variables: Conditions, objects, order, subjects.....	134

LIST OF FIGURES

Figure		Page
1	Tracing patterns: a. a straight line b. a slanting line c. a curve line	89
2	Comparison of total trials to criterion of Subject 1 in learning the photographed objects under the 3 conditions	111
3	Comparison of total trials to criterion of Subject 2 in learning the photographed objects under the 3 conditions	111
4	Comparison of total trials to criterion of Subject 3 in learning the photographed objects under the 3 conditions	111

Chapter 1

INTRODUCTION

A picture is a means of representing three-dimensional concrete objects and events in a two-dimensional form. In learning to use pictures for communicative purposes, a handicapped learner is taught to identify stimuli that are portrayed in the picture (e.g. a picture of a cup). Learning pictorial communication involves two processes of concept learning: discrimination learning and generalization. Discrimination learning involves teaching a learner to distinguish the relevant or discriminative features (e.g. size, shape and handle) from the irrelevant or nondiscriminative features (e.g. color and surface design) of a concept. Generalization involves learning to identify and respond in the same manner to new members of the concept (e.g. different kinds of cups) not used as examples during initial instruction. These new members of the concept class possess all of the discriminative features of the concept (e.g. a handle, a nonpermeable wall, an opening of 16-100cm.) but may possess a variety of nondiscriminative features (e.g. various colors, sizes and shapes) that may not have been present in the examples of the concept that was taught.

A common practice in concept learning or pictorial communication for handicapped learners is to introduce real objects before pictures are used. However, real objects may

possess a number of nondiscriminative, irrelevant, uncontrolled and distracting features that may be reduced in number and salience in pictures. Increasing the salience of the discriminative features or reducing the intensity or number of discriminative features in pictures during initial learning focusses attention on discriminative features and enhances concept learning especially with handicapped learners who have problem in focusing on the discriminative aspects of a stimulus (Zeaman & House, 1963).

When the nondiscriminative features of the concept represented in the picture are removed, a picture may not be a complete representation of the actual object and may therefore, reduce generalization from the picture to the real object. Another issue about using pictures in concept learning is whether color and background should be included. The inclusion of color and background, which are nondiscriminative features of the concept, may impede concept acquisition by distracting attention from discriminative features. However, the inclusion of color and background in a picture provides a realistic representation of the concept in the natural environment and may facilitate generalization.

There has been very little research that has studied the effect of color and background as nondiscriminative features on the acquisition, generalization and maintenance of pictorial concept learning by severely handicapped learners. Information about these effects would have

considerable significance for the preparation of appropriate instructional materials for use with dependent handicapped or severely mentally handicapped learners.

This study has attempted to determine the effect of color and background (as nondiscriminative features of the concept) on the rates of acquisition, generalization and maintenance in concept learning of severely handicapped learners. Chapter 2 includes: a) a review of the literature on pictures as instructional aids to concept learning; b) two processes of concept learning: discrimination and generalization; and c) instructional approaches to concept learning. Chapter 3 identifies the specific research questions and hypotheses to be considered. Chapter 4 describes the methodology and instructional procedures used in this study. Results and discussion are found in Chapters 5 and 6 respectively.

Chapter II

LITERATURE REVIEW

Pictures as Instructional Aids to Concept Learning

Pictures have been commonly used as instructional aids for educational research and practice in concept learning. Some of the areas in which research on the use of pictures has been conducted are: a) picture versus real objects, i.e., whether pictures or real objects are more effective in teaching concepts; b) the relative effectiveness of color, and black and white pictures; and c) the abstractness, complexity and figure-ground relationship of pictures.

Picture versus real object in concept learning. Instructional programs for concept learning, such as the DISTAR Language 1 (Engelmann & Osborne, 1976) used real objects before introducing the pictorial representations of concepts. This program has been used successfully with educable mentally retarded students (Becker & Engelmann, 1973). The usual rationale for using real objects first and later introduce pictures in concept learning is to illustrate that pictures are representations of real objects.

Guess, Sailor and Baer (1976) developed a functional speech and language program for severely handicapped persons. They strongly encouraged the use of objects rather than pictures. Their rationale was that substituting pictures for real objects "decreases the authenticity of the

training environment and reduces the probability that students will apply their new learning elsewhere (p. 4)."

Several researchers have compared the rate of concept acquisition when either pictures or objects were used. Research done by Welch and Pear (1980) found equal rates of acquisition with pictures and objects by 4 mentally handicapped children whose MA ranged from 2 to 3 years with CA 9, 6, 5, and 14 years. Daehler, Perlmutter and Meyers (1976) reported a similar finding in the rate of learning with pictures and objects in normal young children ranging from 24 to 45 months of age.

Becker, Rosner and Nelson (1979) examined the effects of stimulus mode (objects versus pictures) on acquisition, retention, and transfer of novel concepts. Their subjects were a 65 middle-class children. There were 27 boys and 38 girls with an average CA of 60 months. The authors found no significant difference on the acquisition or retention of concepts resulting from the use of either objects or pictures, but the stimulus mode did significantly affect generalization. There was more generalization resulting from picture training than from object training.

Handleman, Powers and Harris (1984) analysed the relationship between the use of concrete objects and pictorial representations of those objects when teaching noun labels to three autistic children. The subjects were 7, 8, 9 years of age, and were functioning in the moderate to severe retarded range of intelligence. The authors found

no consistent functional relationship between the two representational modes but there were no consistent modality effect on generalization.

Hull, Barry and Clark (1976), reported on their study of vocational learning in adolescent learning disabled, educable mentally handicapped and culturally deprived students. Their finding indicated no statistically significant difference in learning concepts with the use of line drawings, detailed drawings, photograms, photographs, 35mm. color slides, or actual objects. They found that line drawings and color slides were the most effective means of teaching concepts.

Devore and Stern (1970) studied the effects of using real objects or pictures in the instruction of young children. The subjects were 36 four years old children. The experimenters found no significant difference in using real objects and pictures to teach environmental concepts, such as doorknob with lock and key, metal doll house, ball, and two bendable rubber figures. The only difference between the two instructional procedures was that instruction with real objects tended to take more time.

Devore and Stern also discussed a number of problems that they encountered in using real objects in their experiment. They found that the use of real objects was costly and required additional custodial care from the teacher. Real objects cannot be easily administered in the program while pictures can be easily administered in

individual or group instruction. The subjects in the study became distracted by the "noise" made in handling the objects. Additional time was required to retrieve dropped objects or objects from the children. It was also difficult for the children to focus on specific parts or functions of the concrete objects presented in the program. With the pictorial presentation, the researchers could direct the children's attention by reducing the details in the pictures and by presenting the relevant features of the stimuli in color for each frame.

Dixon (1981) assessed the picture representation skills of severely handicapped, nonverbal adolescents through photo-object matching tasks. Her subjects were seven severely handicapped adolescents ages 13 years 3 months to 19 years 3 months. Their SQ scores on the Vineland Scale of Social Maturity ranged from 13 to 34. Dixon found that only one subject was able to match photographs with objects. Four of the subjects failed to match photographs with objects because they were attending to the physical properties of the photographs (rectangular edge, flat surface) rather than the figures in the photographs. In view of the results, the author recommended the use of cut-out figures rather than complete rectangular photographs to enhance photograph-object matching.

Baine (1982) stated that one of several problems with the use of real objects in concept teaching is that real objects possess many more irrelevant, uncontrolled and

distracting features than are be found in "simplified" pictures in which nondiscriminative and discriminative features can be controlled. Increasing the salience of the discriminative features or reducing the intensity or number of nondiscriminative features in pictures during initial training enhances concept learning especially with children with learning difficulties who have problems in focusing on the discriminative aspects of a stimulus (Zeaman & House, 1963).

A critical factor in the use of pictures depends on whether the learner can recognize and understand the picture as a representation of the real object. Gibson (1969) suggested in her research of perceptual development that picture representation of objects requires little or no learning beyond the perception of objects themselves. She found that young normal children learned the features of objects when they were presented in photographs or outline drawings. Kennedy (1974) reviewed a number of studies of picture perception and concluded that successful picture perception did not depend on age, education or level of intelligence. Daehler, Perlmutter and Meyers (1976) demonstrated transfer of learning from photographs to objects and from objects to photographs by normal children as young as 24 months.

The relative effectiveness of color or black and white pictures. Color has been used as an attention gaining device and has been assumed to provide learners more

information cues and more stimulation. Hence, it has been theorized that color presentations would enhance learning. However, the effectiveness of using color in improving learner's achievement remains inconclusive.

Dwyer (1971) conducted a series of closely related studies with a single lecture on the human heart and examined in successive studies the different effects (drawing test, identification, terminology, comprehension) of a variety of pictorial treatments (line drawing, shaded drawing, model, photograph - all in either black and white, or color) in a variety of media (slides, television, programmed instruction) for a wide age range of university students.

She found that the variety of pictorial presentations did not automatically improve learner achievement and that different types of color and black and white illustrations (eg. line drawing, shaded drawing, model, photographs) differ in their effectiveness in improving learning and comprehension. The results indicated that pictorial treatments constantly interacted with instructional objectives and with media types throughout the study.

Kanner (1968) reviewed research done on the effects of black and white or color and found that color presentation did not improve cognitive learning. In some instances, the black and white presentation had a better effect than the color presentation.

Spangenberg (1976) reviewed research done on the effects of black and white and color on learning. He concluded that color evoked an increase in visual attention but it did not ensure adequate learning and there was no reliable difference in performance from learning realistically colored or black and white materials.

VanderMeer (1954) studied the effects of black and white and color on 40 ninth-grade science students. He found that the inclusion of color in educational material did not significantly increase learning or enhance immediate acquisition of the materials but helped in long-term retention of learned material. Chute's finding (1980) in his study of task-relevent learning is also consistent with VanderMeer's result that color cuing may be more valuable for enhancing long-term retention.

Katzman and Nyenhuis (1972) studied the effects of color on the recall of peripheral visual and verbal information in a slide presentation. Two identical experiments were conducted, one using 26 paid male college students and the other 34 paid female subjects. They found that color did not improve the learning of the central material (content that was relevent to the basic information) but promoted recall of peripheral pictorial material (irrelevent material that was not central).

Chute (1980) compared the effects of viewing color and monochrome versions of an instructional film on discrimination learning. Subjects were 48 fourth- and 42

fifth- grade elementary school students. He found that color treatment facilitated the learning of task-related information for high-spatial aptitude students, but seemed to inhibit learning for the low spatial-aptitude students. Chute stressed that the effectiveness of color cuing strategies should be considered in terms of the aptitudes of learners, the type of learning required, the category of color cuing employed, and the role of other cues in the media presentation studied.

In reference to the learner's aptitudes, Chute (1979) stated that color may add more information and stimulation to the media presentation to such an extent that an individual learner is unable to process all the pertinent information. The human information processes could become so overloaded that a learner could mistakenly attenuate some of the relevant information and focus on the irrelevant ones.

This observation concurs with the generalization drawn by Allen (1975) from review of literature on aptitude-treatment interaction research. He concluded that high mental ability learners were capable of processing greater amount of sensory information than were learners with low mental ability. Learners with low mental ability, as described in Allen's study, were learners with deficits in abstract reasoning, attention, perceptual coding, perceptual processing, and analytical skills. The learners

with high mental ability were those who possessed all these skills.

Klein, Klein, Oskamp and Patnode (1972) examined the behavioral and physiological characteristics of discrimination with color distractors on retarded and non-retarded children. Ten non-retarded regular grade 1 students ages 6 - 7 years old and ten educably mentally retarded special class students, ages 6 - 10 years with a mean of 8 years. The authors found that retarded children made significantly more errors than the non-retarded children. They also discovered that the color distractors affected the performance of the retarded children more than that of the non-retarded children.

Rutherford, Casey, Hasterok and Howell (1979) studied the function of color in learning an assembly task by learning disabled adolescents of normal intelligence. Mean age of the subjects was 16.3. One group of subjects viewed a black and white film illustrating a puzzle assembly. The other group viewed an identical film of the puzzle begin assembled in color. The authors found that the presence of an extraneous cue, color interfered with learning by inhibiting the students' ability to choose and attend to the critical cues of the task.

Nathanson (1977) investigated the relationship of cognitive processes used by severely mentally retarded and the specific properties of stimuli used in television broadcasting. His subjects were 36 male and 36 female

severely retarded teenagers with CA=197.68 months and mean IQ=43.7. He discovered that black and white visual presentations had greater attentional value than color presentations. He further suggested that color caused satiation of attention at an earlier stage of viewing than did the black and white presentation. His subjects were less attentive to the color stimuli than to the black and white stimuli as viewing time increased.

There is very little research of the effect of color on severely handicapped individuals. The available research on color and black and white materials related to severely handicapped does suggest that color tends to distract and interfere with discrimination and attention of the severely handicapped persons. The effect of color, as a discriminative or nondiscriminative feature in concept learning is further discussed in the section under discrimination learning.

Abstractness, complexity and background of pictures. According to Silverman (1980), the level of abstraction and complexity should be considered when designing pictorial communication for the handicapped. The level of abstraction of a picture is the amount of information or detail that is included in the pictured object or activity. The detail may range from relatively high levels of abstraction to relatively low levels of abstraction, such as from a line drawing to a color photograph. Silverman (1980) suggested

that pictures are more suitable for training concrete than abstract concepts.

The level of complexity, according to Silverman (1980) is a partial function of the extent to which the foreground stands out from its background. The foreground of a picture is the concept or object that the picture is intended to communicate. The background is all other details in the picture that are irrelevant to the concept or object depicted.

Silverman stated that the level of complexity of pictures should be kept to a minimum. The greater the separation between the foreground and background, the lower the level of complexity. As an example, a photograph of a person drinking from a glass that was taken against a white background probably would be less complex than one of the same person drinking from the same glass with kitchen cupboards in the background.

Goodman (1980) studied picture memory and the manner in which action schema affects retention. Her subjects were 12 normal children in each of the 7 and 9 years age groups and 12 students with a mean age of 19 years 4 months. She identified a number of factors that should be considered in designing pictures and in assessing children's picture memory. She found that the relevance of items in a picture to the salient activity that is depicted and the location of objects in a picture, foreground or background, influenced the perception and retention of details by children.

Baine (1982) after reviewing some of the literature on the use of pictures for concept learning made some tentative conclusions about the use of pictures to teach concepts to handicapped learners. He suggested that real objects may be distracting and difficult to control variations in discriminative and nondiscriminative features of the concepts. Simple stimuli in a nondistracting environment should be used in the initial training. Young children can recognize and learn concept from pictures and outline figures. He noted that for preschool children, the evidence indicated that there was no difference in the rate of acquisition or duration of retention of newly learned concepts when they were taught by use of either objects or pictures. The use of pictures enhanced the generalization of newly learned concepts.

Baine suggested a few guidelines for developing an instructional sequence for teaching concepts with pictures. Initially, simple and realistic pictures or line drawings should be used. Unessential shading and detail in the pictures should be avoided. Following initial learning, more nondiscriminative features and detail should be gradually faded in to approximate a more life-like representation. In the initial training, when color is included as a nondiscriminative feature in the picture, an unsaturated hue may reduce distractability. Photographs and real objects in which there is an uncontrolled variation in

nondiscriminative features of the concepts may be used in the final phase of training.

Although some program designers prefer using real objects in the initial teaching of concepts, pictures can be a viable alternative for concept learning. There are no research results to show any significant difference between the effect of using picture and of using real object for handicapped learners. Some research has demonstrated that pictures enhance generalization. Picture can be easily administered in the learning situations. The amount of discriminative and nondiscriminative features of the object or activity represented in the pictures can be controlled. The role of color in concept learning is not clear. Color presentation may not necessarily improve concept learning and may act as a distractor. Other influential factors are the aptitudes of the learner, the type of learning required, and the amount of color cuing used. One of the variables in the pictorial presentation is the abstractness, complexity and background of the picture. The more abstract and detailed the background of the picture the more difficult concept learning may be.

Processes of Concept Learning : Discrimination Learning and Generalization

The use of pictures as a means of communication for dependent handicapped persons has been found to be successful when verbal language training or other symbolic communication such as manual signing has not been effective

(Lancioni, 1983; Murphy, Steele, Gilligan, Yeow, & Spare, 1977). When a picture is used as a medium of communication, it represents objects or activity in the environment, for example, a picture of a cup is a representation of an actual cup. The typical training procedure for pictorial communication is to teach a dependent handicapped person to make a motor response (e.g. point with index finger) to a picture to indicate a desired object or activity. Thus, the dependent handicapped person is required to learn :

1. to understand the concept that the picture represents an object/activity;
2. to identify and discriminate pictures from each other when more than one picture is presented;
3. to match the sample or the verbal label of the object/activity that the picture represents (Keogh & Reichle, in press).

These requirements involve the two processes of concept learning : discrimination learning and generalization.

A concept, as defined in behavioral term, by Becker, Engelmann and Thomas (1975), is "the set of stimulus characteristics uniquely common to a set of stimulus instances in a given universe and not common to other concepts in that universe." (p.133). These authors described conceptual behavior as a special case of operant behavior brought under the control of discriminative stimuli through differential reinforcement. In the presence of certain stimuli only appropriate responses are reinforced.

In the absence of these particular stimuli, the responses are not reinforced. A concept instance is defined as an example that can be used in teaching; an example or instance of red might be a red apple or red crayon. Positive instances and negative instances are examples and nonexamples of the concept being taught. A red apple may be used as an example of the concept "red" while a green apple or a black cat may be used as nonexample of the concept "red". According to Becker, Engelman and Thomas (1975), there are three stimulus properties in positive instances (examples) or negative instances (nonexamples). The first property is the discriminative features or irrelevant characteristics of both examples and nonexamples. The second is the nondiscriminative features of the examples and nonexamples. The third is the stimulus characteristics that are common to the instances of two or more concepts. The common characteristic of these concepts form the formulation for high-order concepts and explain the relationship among concepts. For example, a blender and an iron share the common characteristics of being household items. One of the discriminative features of a blender that distinguish it from an iron is the row of push buttons on its base. One of the discriminative features of an iron that can be distinguished from a blender is the handle or the point-shaped base. The color of the blender and iron is a nondiscriminative feature of the two items because color is irrelevant for discriminating these objects from each other.

The process of learning to discriminate and respond appropriately when both relevant and irrelevant concept instances are presented through the use of differential reinforcement is described as discrimination learning (Becker, Engelmann & Thomas, 1975). Discrimination involves distinguishing: 1) the discriminative or relevant characteristics from the nondiscriminative or irrelevant characteristics of the stimuli within positive and negative concept instances (ie. examples and nonexamples), and 2) the discriminative or relevant characteristics of the concept being taught from the other concepts. (Becker, Engelmann & Thomas, 1975).

The other process involved in concept learning is generalization from the original learning conditions. The goal of concept teaching as stated by Becker, Engelmann and Thomas (1971) is as follows :

> "A concept has been taught when any or all members of the concepts set are correctly identified (responded to in the same way) even though some were not in the teaching set, and any or all not-members of the concept set are responded to in a different way." (p. 238).

When the learner correctly identifies new members of the concept set which were not observed in the initial training conditions, it is said that generalization has occurred. The success of concept learning depends not only on the ability of the learner to discriminate positive or negative instances of the concept taught but also on his

ability to generalize the learned concept to other conditions.

The next section will review literature on discriminative learning and will be followed by a review of generalization.

Discrimination learning. According to Zeaman and House's (1963) attention theory of discrimination learning, the learner must learn to attend to the relevent dimension and to select the correct cue of that dimension. They hypothesized, further, that the number of relevent stimulus dimensions controls the rate of discrimination learning. Based on their data from a series of experiments with moderately handicapped and trainable children, they found that their subjects learned in a faster rate when the objects to be discriminated contained two relevent dimensions, such as color and form than when only one of the relevent dimension was present. They also found that their subjects learned even faster when the discriminant objects, such as an aluminum pot cover versus a green plastic soap dish, differed in numerous and unidentified dimensions than when objects with only two relevant dimensions were involved. This type of learning was referred to by Zeaman and House as multidimensional object (junk) discrimination which is the easiest discrimination to learn. The rationale is that the more relevant dimensions available for making the correct selection of cues the greater the chance of

making the right selection and the more rapid the discrimination learning.

The same authors found that mentally handicapped individuals have difficulty attending to certain relevant dimensions in stimuli. They theorized that the difficulties of the mentally handicapped individuals had on discrimination learning were not solely due to their intelligence but rather to an attention deficit of attending only to a limited number of dimensions. For example, mentally handicapped individuals may attend to an irrelevent dismension such as color and neglect relevent dimensions such as shape or size. Zeaman and House reported that when a mentally handicapped individual learned to focus attention on the relevent dismension, his/her ability to select the correct cue within that dimension was the same as that of normal individuals.

Ullman and Routh (1971) investigated the role of the number of relevant stimulus dimensions in the discrimination learning of mentally handicapped and nonhandicapped children. The subjects were 48 handicapped children (mean IQ = 58.8) and 48 nonhandicapped children (mean IQ = 98.0) of equal MA (6 years). Twelve subjects from each IQ group learned a two-choice visual discrimination task with either 1, 2, 4 or 8 relevant dimensions. The findings supported the hypothesis that increasing the number of relevant dimensions decreases the number of errors made by both nonhandicapped and handicapped children in discrimination

learning. These results were consistent with Zeaman and House's (1963) hypothesis that the number of relevant dimensions controlled the rate of discrimination learning.

Stimulus oversensitivity, a phenomenon of responding only to a limited amount of relevent cues available in a learning task, has been observed in both autistic and mentally handicapped populations (Lovaas, Schreibman, Koegel, & Rehm, 1971; Wilhelm & Lovaas, 1976). In the Lovaas et al. (1971) study, autistic, mentally handicapped, and normal subjects were taught to respond to a complex stimulus which consisted of auditory, visual, and tactile component cues. These three component cues of the stimulus were later presented individually to the subjects. The presentation was intended to determine which of these cues controlled each subject's responding. The results indicated that autistic subjects responded to only one component cue, mentally handicapped subjects responded to two component cues, and normal subjects responded to all three.

Wilhelm, and Lovaas (1976) further investigated the relationship between IQ and the number of cues used in a discrimination learning situation. Their subjects were three groups of children with different IQ levels. Each group had 10 subjects. The first group consisted of severely handicapped children with mean IQ = 39.3 and a mean CA = 15.8 years. The second group of moderately handicapped children had a mean IQ = 66.1 and a mean CA = 14.3 years. The third group of normal intellectual functioning had a

mean CA = 11.1 years. They found that the severely handicapped group responded on the average to 1.6 cues, the moderately handicappped group responded to 2.1 cues on the average. The normal group responded to all 3 cues. These findings supported the hypothesis that stimulus overslectivity is a commmon feature of both autism and mental retardation, and that IQ is an important variable related to cue use in discrimination learning. The researchers speculated that the degree of stimulus overselectivity may be correlated with the degree of retardation; and the lower a person's IQ level, the less of the environment becomes functional in controlling his behavior. Because of overselective attention, a handicapped child is unable to select the relevant cues in his environment and is unable, therefore, to behave appropriately.

Ellis, Deacon, Harris, Poor, Angers, Diorio, Watkins, Boyd and Cavalier (1982) assessed the trainability of the mentally handicapped population by studying discrimination learning, memory and transfer in profoundly, severely, and moderately mentally handicapped persons. The subjects in the study were 56 institutionalized mentally handicapped persons. Four groups of 14 subjects were divided according to their IQ levels. The moderately handicapped group had a mean CA = 25.7 and a mean IQ = 43.8. The severely handicapped group had a mean CA = 28.6 years and a mean IQ = 22.2. The mean CA and IQ of the high profoundly handicapped

group were 26.1 years and 12.1 respectively. The mean CA and IQ of the low profoundly handicapped group were 26.9 years and 8.0 respectively. The authors found that there was no significant change in performance among the 7 low profoundly handicapped subjects for the first 216 trials. Following this point, learning began and during the last 27 trials, the subjects were able to master the discrimination problems at the same rate as the high profoundly and the severely handicapped subjects. These results seemed to suggest that the most important training task for the profoundly handicapped learners was to learn to attend to the relevant cue(s) (Ellis, et al., 1982). The results of the previously cited studies illustrate that because of the attention deficits and stimulus overselectivity of mentally handicapped learners, it is important to teach them to attend to the relevent cue(s) or discriminative features of the stimulus in discrimination learning.

Many research studies have demonstrated the effectiveness of teaching mentally handicapped learners to attend to the discriminative features of the stimuli (Crawford & Siegel, 1982; Guralnick, 1975; Wolfe & Cuvo, 1978). Wolfe and Cuvo (1978) compared the effects of using within-stimulus and extra-stimulus prompting to teach letter discrimination to mentally handicapped students. There were 24 mentally handicapped subjects with MA = 3 years 1 month; mean IQ = 28 and mean CA = 21-10. In the within-stimulus prompting condition, the critical features of the letters

were highlighted by increasing their height and width. In extra-stimulus prompting condition, the experimenter prompted the subjects by pointing his finger to the letter. Both types of prompts were gradually faded out. The authors found that the within-stimulus prompting was a more effective instructional method than was the extra-stimulus prompting. Teaching the mentally handicapped students to attend to the discriminative features of alphabet letters by highlighting critical features not only improved learning, but also generalization and maintenance. Wolfe and Cuvo concluded that exaggerating the discriminative features of a stimulus was more effective than adding a qualitatively different cue to the stimulus.

Guralnick (1975) investigated the effect of discriminative feature training and instructional technique on letter and form discrimination of mentally handicapped children. His subjects were 32 handicapped children with mean (PPVT) IQ = 41.8 and mean age 8.43 years. The subjects were assigned to one of four groups : 1) control; 2) discriminative feature matching-to-sample training; 3) discriminative feature plus fade-in training in which the initial training was the same as the second group but three additional levels were added to permit fading-in of the nonessential elements of the letter forms, and 4) the highlighting training in which the critical segments of the letters were contrasted by differentially coloring these segments. The author found that all three training

procedures facilitated letter discrimination. He concluded that teaching the handicapped children to attend to the discriminative features of certain alphabet letters faciltated later discrimination of those forms.

Crawford and Siegel (1982) evaluated a training strategy for teaching mentally handicapped children to attend to various features of a visual display. The authors hypothesized that verbal feedback "right" and "wrong" and gestures to point out the cue similarities and differences to the subjects as a confirmation of correct or incorrect responses would enhance discrimination in matching-to-sample tasks. Their subjects were 82 educable and trainable handicapped students (IQ = 34-69, CA = 6-18 and MA = 3.7-10). The subjects were assigned to 3 conditions: 1) training with elaborated correction following each response; 2) training with no feedback, and 3) no training with only assessment and reassessment. The authors found that the training group subjects identified more cue dimensions correctly during the reassessment with fewer confusion errors than did the other two groups. The training group subjects also showed individual improvement in the number of dimensions identified and in a reduction of confusion errors from the assessment to reassessment test. The subjects also exhibited total intradimensional transfer, that is, training from one particular set of cues to new cues of the same dimensions. The authors thought that the elaborated correction served to enhance cue differences. In support of

Zeaman and House (1963), this strategy directed the subject's initial attention to the relevant dimension of the stimulus and thus improved the discrimination learning of the subjects.

The fade-in procedure is a strategy used to facilitate discrimination learning by increasing the salience of critical features. Guralnick (1975) investigated the effect of discriminative feature training and instructional technique on letter and form discriminative mentally handicapped children. As reported in the earlier section, he used discriminative feature plus fade-in training as one of the experimental conditions. Three additional levels were added to permit fading-in of the nonessential elements of the letter forms. He found that this and the other training procedures (i.e., discriminative feature matching-to-sample training and the highlight training) were effective in facilitating letter discrimination.

Westling and Koorland (1979) recommended the use of the fade-in technique in discrimination learning. This technique is based on the theory of errorless learning. Instead of introducing the incorrect stimulus all at once in the initial learning of the correct stimulus, the incorrect stimulus is gradually faded-in. At first, the incorrect stimulus would be almost unnoticeable. As the training progressed, the incorrect stimulus would become of equal sight or intensity as that of the correct stimulus.

Tracing of the discriminative features was used by Zimmerman and Jaffe (1977) to study concept learning of thirty-six 6 and 8 years old normal children. In a high-structure condition, the teacher looked at 12 pictures that represented three concepts: things that roll, rectangular things, and pointed things, pointed to the critical feature and then placed each picture according to the concept that it represented. For pictures that depicted things that roll, the teacher made a circular gesture around the rolling surface. For pictures depicting pointed things the teacher traced one right angle corner of the shape. Levin, Ghatala, De Rose and Makoid (1977) investigated the effectiveness of image tracing in children's pictorial discrimination learning. They found that tracing from memory of pictorial discrimination pairs greatly facilitated learning.

Simultaneous presentation of the examples and nonexamples to facilitate discrimination learning is recommended. Becker, Engleman and Thomas (1975) suggested the presentation of pairs or several of the examples and nonexamples so that the learner can examine their similarity and differences. Other studies (Granzin & Carnine, 1977; Reese & Lipsitt, 1970) have found that learners showed better performance when the stimuli were presented simultaneously rather than successively (i.e., one at a time). Westling and Koorland (1979) stated that mentally handicapped learners achieved faster in two choice

situations during initial training. When simultaneous presentation is employed, the instructor should initially introduce concept pairs that are least confusing and later introduce more confusing ones.

The foregoing research studies have illustrated various prompting devices and strategies to help mentally retarded subjects to attend to critical stimulus features during discrimination learning. The prompting devices used such as tracing, highlighting, fading-in and fading-out techniques, verbal feedback, gesturing to critical features and simultaneous presentation were successfully used to increase the salience of discrimination features and to attract the subjects' attention.

Discriminative features and nondiscriminative features of stimuli. As mentioned before, discrimination involves distinguishing the discriminative features from the nondiscriminative features of a stimulus presented. The learning of concrete concepts such as objects, requires a learner to classify one or more familiar and unfamiliar objects within the same class. Objects of the same class possess similar discriminative features but may have different nondiscriminative features. Research (Anderson & Faust, 1974; Brown, Shenerman, Cartwright & York, 1973; Clark, 1971; Lubker, 1969) has shown that systematic control in the presentation of discriminative and nondiscriminative features of stimuli in discrimination learning can enhance the learner's performance. For example, increasing the

salience of the discriminative features and holding the number of nondiscriminative features constant in initial learning directs a learner's attention to the discriminative features and reduces distraction of the nondiscriminative features of a stimulus.

Lubker (1969) studied the effects of concurrent presentation (within setting) and successive presentation (between setting) of number (0, 1 or 2) of irrelevant dimensions in children's simultaneous discrimination learning. Her subjects were 120 third and fourth grades children from age 7 years 10 months, to 11 years, 1 month. Twenty four subjects were assigned randomly to each of the five simultaneous discrimination problems. Form was the relevant stimulus dimension in each problem. Brightness, size and position were irrelevant dimensions. The problems were identified by the number of irrelevant dimensions (other than position) varying within settings and between settings. The results indicated that the presence of the irrelevant dimensions within a pair of examples and nonexamples reduced the rate of concept acquisition. Performance was improved when no irrelevant dimensions were represented in either within or between settings in comparison to the situation where two irrelevant dimensions were presented in between settings.

Clark (1971) reviewed 40 experimental studies conducted in the area of concept acquisition. These studies suggested that the following modifications of discriminative and

nondiscriminative features of the stimuli would generally increase the ease of concept acquisition:

1. decrease in number of nondiscriminative feature presented in the stimulus.
2. increase in the salience of the discriminative features and decrease salience of nondiscriminative features.
3. decrease the variation of each nondiscriminative feature, if discriminative features vary from stimulus to stimulus.
4. increase the variation of each nondiscriminative feature when the discriminative feature is held constant.

Anderson and Faust (1974), recommended that nondiscriminative features should be temporarily removed in the initial stage of concept learning and reintroduced when the criterion was reached with the "simplified" materials with only the discriminative features presented (Baine, 1982). Brown, Shenerman, Cartwright, and York (1973) conducted 15 classroom programs with 14 severely handicapped students (IQ = 30-40, and CA = 5-10). In the initial concept training, only one relevant stimulus dimension (size) was available upon which the two stimuli could be discriminated; that is the stimuli were identical except for size. Once the criterion level of responding was reached, various irrelevant stimulus dimensions (color, shape, texture) were included in the pairs of stimuli. This procedure was successful in teaching students to acquire the concepts with few learning trials.

Baine (1982) discussed guidelines for teaching concrete concepts and some of the advantages of controlling the discriminative and nondiscriminative features in the stimuli (examples and nonexamples). He suggested that the advantage of increasing the salience of the discriminative features was to reduce the number of features to which a learner has to attend, and accelerate identification of critical features, and thereby increase the rate of concept acquisition. The advantage of introducing nondiscriminative features to both examples and nonexamples after the discriminative features have been identified is that the stimuli become more representative and reflect the variations found in the natural environment. This procedure improves generalization.

When nondiscriminative features are introduced, they should be represented in both examples and nonexamples. This will help the learner to identify that the added feature is nondiscriminative. The nondiscriminative features should be introduced between successive pairs of examples and nonexamples which will reduce the interference with the rate of concept acquisition and familiarizes the learner with changes in stimulus qualities.

When teaching fixed discriminative feature, the advantage of presenting pairs of examples and nonexamples in which the only difference between the stimuli is the presence or absence of the fixed feature is to direct the

learner's attention to the discriminative feature and its fixed value in the examples.

Color functions as a discriminative or nondiscriminative feature. As mentioned in the previous section, the findings of past research have demonstrated that color may enhance or impede discrimination learning. The inconclusiveness of the research may be due to the lack of a clear identification of the function of color in instruction. On the basis of the former discussion of discriminative and nondiscriminative features, it is apparent that in discrimination learning the effect of color as a discriminative feature may be totally different from the effect of color as a nondiscriminative feature. For example, if color is a discriminative feature of a stimulus, attending to color will improve discrimination learning. On the other hand, if color acts as a nondiscriminative feature, it may distract a learner's attention and interfere wth his/her performance. Chute (1979) emphasized that the importance of color as a media attribute that influences human learning depends on the degree to which color cues can facilitate the organizing and structuring of the learning task presented. He classified two types of color cues: (a) integral color cues and (b) intrinsic color cues. Integral color cues are color stimuli that delineate figure-ground relationships, show interrelatedness, and assist discriminations; and they are integral to the interpretation of the meaning of the visual array. Intrinsic color cues are color stimuli that do not

supplant these functions; they are incidental to interpretation and are included only because they are intrinsic parts of subjects that appear in the visual array. These classifications bear similarity to the definitions of discriminative and nondiscriminative features. Chute (1980) found that when color is used in a fixed-pace media treatment, increased use of integral color cueing and decreased use of intrinsic color cueing may benefit low-spatial aptitude students.

Meador (1984) studied the effect of color on visual discrimination of geometric symbols (lexigrams) by severely and profoundly mentally handicapped individuals. Her subjects were 10 males and 10 females with mean MA = 1.92 years; mean CA = 23.17 years and mean social age = 4.25 years. In a series of experiments, Meador reached the following conclusions:

1. discrimination training with irrelevant color cues on the backgrounds of lexigrams did not improve the visual discrimination of lexigrams. The subjects failed to transfer to the same lexigrams on black backgrounds. These results suggest that the subjects learned the color, rather than the form discrimination.
2. random assignment of color to the lexigrams facilitates visual discrimination. Discriminative training with randomly colored lexigrams transferred to the same lexigrams in black.

3. discriminative feature training with color being randomly assigned to the discriminative feature of the lexigram while the remaining features were black, improved visual discrimination among highly similar lexigrams with only one discriminative feature and tranferred both to black whole lexigrams and black discriminative features at higher levels than did training with random coloration of entire lexigrams.
4. when the relevant color cues were assigned to the lexigrams or discriminative features as opposed to their backgrounds, the subjects might have been forced to attend to both color and form dimensions.
5. the effectiveness on discrimination training for facilitation of simple discriminaton learning by severely and profoundly mentally handicapped was supported.

Meador's study (1984) illustrated the difference in the effect of color as a discriminative and a nondiscriminative feature. When color was used as a discriminative feature, it improved the learner's performance while as a nondiscriminative feature, color distracted the learner's attention and interfered with learning.

Generalization. Generalization of concept learning is said to occur when a learner can identify new members of the concept set which had not include in the initial training (Becker, Engelmann, & Thomas, 1975). The new members of the concept share all or some discriminative features of the

concept but may also possess a variety of nondiscriminative features that may not be present in the concept that is taught. When the learner consistently responds in the same manner to the new members of the concept that were not included in the initial training, he has shown generalization within a concept class. The process of generalization has traditionally been regarded as a passive, automatic process while discrimination learning has been viewed as an active process to be systematically included in instruction. The assumption was that once the individual learned a set of concepts, he would transfer the learned concept to various appropriate settings or conditions. Research has demonstrated that such a transfer of stimuli does not always occur (Koegel & Schreibman, 1974). Mentally handicapped individuals frequently fail to generalize skills when no instructional programming has been done in the natural environment (Stokes & Baer, 1977). For these individuals to generalize a concept or skill that they learned methods of promoting generalization must be systematically included in the intervention or training process.

This section provides an overview of the nature of generalization and the components of an instructional program likely to affect stimulus generalization. Methods used to achieve generalization in the present study will be discussed.

An overview. Stokes & Bear (1977) reviewed 270

studies that involved generalization. According to these authors, the definition of generalization is :

> The occurrence of relevant behavior under different, non-training conditions (i.e., across objects, settings, people, behavior, and/or time) without the scheduling of the same events in those conditions as had been scheduled in the training condition.(p.350)

Stokes and Baer (1977) abstracted from the literature nine general techniques designed to assess or train generalization. A number of these procedures are discussed below :

1. Train and Hope. The "Train and Hope" approach to generalization is the most frequently used method reported in the research studies. No generalization training is explicitly included in instruction. It is hoped that after initial training, generalization will occur over time, persons, and settings. In concept learning, simply presenting a random selection of examples with no effort to control discriminative and nondiscriminative features may be an acceptable strategy for high functioning, experienced learners; but may be difficult for severely handicapped learners.
2. Sequential modification. In this procedure, generalization is assessed after the behavioral change program. If generalization has not occurred, scheduling of systematic sequential modification in every non-generalized conditions is undertaken, and instruction is conducted, for example, across responses, subjects, settings or experimenters.

3. Introduction of natural maintaining contingencies. This technique involves transfer of behavioral control through the introduction of natural reinforcement contigencies that maintain and generalize the learner's newly acquired skills.
4. Training of sufficient exemplars. This procedure involves the training of sufficient exemplars (rather than all) of the untrained stimuli, conditions or responses to promote generalization beyond the intervention conditions.
5. Train loosely. With this technique, little control is exerted during training over the stimuli presented so as to promote wider generalization to other situations.
6. Using indiscriminable contigencies. This method includes the use of intermittent and delayed reinforcement to promote resistance to extinction and encourage maintenance and generalization of behavior.
7. Programming common stimuli. When this teaching is employed, common and salient stimuli are presented in both training and generalization settings, to assist transfer of stimulus control from one setting to other.
8. Mediated generalization. Generalization is achieved in this procedure through the use of self-control, self-recording and self-administration of reinforcement.

Various instructional components that affect stimulus generalization. Donnellan and Mirenda (1983) analyzed various aspects of instructional programs that are likely to

affect stimulus generalization (generalization across persons, settings and materials) with severely handicapped students. The authors identified five instructional components that may affect generalization: (a) selection of the target behavior; (b) selection of the antecedent stimulus events; (c) selection of contingencies; (d) selection of instructional methods and (e) the interactive effects of two or more of these components. The effects of these components are discussed below.

According to the literature reviewed by Donnellan and Mirenda, the strategies for selecting curricular content for severely handicapped students are based on the "low inference" model. This means that the skills that are taught under one set of conditions will not automatically transfer to another set of conditions (Brown, Nietupski & Hamre-Nietupski, 1976).

Research has indicated that skills are likely to be generalized and maintained if they are: (a) functional (Brown, Branston, Hamre-Nietupski, Pumpian, Certo & Gruenewald, 1979); (b) reinforced by natural occurring events in the environment (Baer, 1981; Stokes & Baer, 1977); and (c) are important to social and/or communicative interactions (Berler, Gross & Drabman, 1982; Gable, Hendrickson & Strain, 1978). However, according to Donnnellan and Mirenda (1983), there is very limited research to support or reject such contentions.

There are four antecedent conditions: a) environments, b) materials, c) trainers and d) cues that may be considered when attempting to promote generalization of newly acquired skills. Contradicting results have been found in research that has studied generalization under natural versus artificial environments. For example, some studies have shown that skills that were learned in the natural environment were more likely to be generalized than when they are learned in artificial settings (Coon, Vogelbberg, & Williams, 1981; Hill, Wehman & Horst, 1983). Other studies (Page, Iwata & Neef, 1976; Neef, Iwata & Page, 1978) have shown that generalization to natural environment occurred after classroom-based instruction without training in the natural setting.

Studies of natural versus artificial materials (Mansdorf, 1977; Nutter & Reid, 1978; Welch & Pear, 1980) have suggested that highly representative and/or real materials have enhanced generalization (Donnellan & Mirenda, 1983). This component of natural versus artificial materials will be discussed later in relation to the present study.

Several research studies (Albin, 1977; Coleman, Whiteman & Johnson, 1979) have indicated that using a variety of trainers in the initial acquisition phase promotes later generalization. Very limited research has been done on the effect of natural versus artificial cues on generalization. Simic and Bucher (1980) reported that

natural, situational cues resulted in greater generalization than did artificial cues.

Many studies (Gable et al., 1978; Halle, Marshall & Spradlin, 1979) have demonstrated the effects of artificial versus natural reinforcement in teaching severely handicapped individuals. The findings indicate that natural reinforcement enhances generalization. Donnellan and Mirenda (1983) reported that no research has examined the effect of natural versus artificial schedules of reinforcement.

In regard to selection of instructional methods, studies have demonstrated that cumulative or concurrent training results in greater generalization than does successive training (Panyan & Hall, 1978; Waldo, Guess & Flanagan, 1982). There has been no conclusive research demonstrating the effects of one-to-one versus group instruction. It could be inferred, however, that group instruction might be expected to enhance generalization (Donnellan & Mirenda, 1983).

Two other important components of instruction that may facilitate generalization were mentioned by Donnellan and Mirenda (1983). One of them is that a combination of the above-mentioned components could have an interactive effect on generalization. This aspect of interactive effects warrants further investigation.

Strategies to facilitate generalization. Based on the literature reviewed, Donnellan and Mirenda (1983) listed a

few empirically validated strategies that seem to facilitate generalization for the severely handicapped students:

1. Use of real materials or at least highly representative pictures.
2. Use of naturally occurring antecedent cues rather than artificial instructional stimuli.
3. Use of multiple trainers which is similar to "training sufficient exemplars" (Stokes & Baer, 1977).
4. Natural reinforcement e.g. from peers, which is similar to "introducing to natural maintaining contingencies" (Stokes & Baer, 1977).
5. Cumulative presentation which is equivalent to Stokes and Baer's "train loosely" approach.

Methods used to achieve generalization in the present study. It is the purpose of this study to examine the generalizability of highly representative photographs to the real objects they represent. This process of generalization is very crucial to language training programmes and pictorial communication for severely handicapped. One common practice in language training is to teach children to identify stimuli that are illustrated by colorful pictures (e.g., Biberdorf & Pear, 1977; Olenick & Pear, 1980). It is generally assumed that when the children can identify the photographed objects, they can also identify the real objects when they see them in their natural environment.

Welch and Pear (1980) compared the three training stimuli: picture-cards, photographs and real objects to

determine which best enhanced generalization of naming responses to real objects in the natural environment. Subjects in the study were mentally handicapped children CA = 5-14 and MA = 2-3.5. Three of the four subjects showed greater generalization to the real objects in the natural setting when they were trained with real objects. The remaining subject showed substantial generalization regardless of the training stimulus mode.

Hupp and Mervis (1981) studied generalization by applying the best-example theory to category learning. The theory predicted that presenting only the most representative exemplars of a category during instruction would produce more accurate category generalization after initial training. Subjects in the study were 6 severely handicapped students ranging in age from 8 to 18 years who had representational ability, could imitate simple actions and could match photographs to objects. Signing was chosen as the teaching mode. Each subject was taught to label 2 categories of photographed objects within three different experimental conditions. Each experimental condition tested the effects of a different strategy for selecting photographs to represent categories of objects. The experimental conditions were: (a) teaching two manual signs using one good exemplar to represent each of the two categories; (b) teaching two manual signs using three good exemplars to represent each of the two categories; and (c) teaching two manual signs using one good exemplar, one

moderate exemplar, and one poor exemplar to represent each of the two categories. The results of the study indicated that conditions with either one or three good exemplars showed significantly better generalization to real objects than in conditions using less representative exemplars. Another finding was that presenting three good exemplars resulted in more accurate generalization than when only one good exemplar was presented. Based on the results of these findings the use of real objects or highly representative materials might facilitate generalization.

Although Guess, Sailor and Baer (1976) strongly discouraged using pictures rather than objects in establishing language skills for severely handicapped person, there are a few advantages of using pictures. Pictures, especially high-quality photographs, bear strong physical similarities to the objects photographed. The relationship between a photograph and an object is not arbitrary as in some manual signing or symbolic representations (Dixon, 1981). Pictures are convenient to use as training stimuli; the salience of discriminative features can be controlled while the number and intensity of nondiscriminative features of the stimuli can be reduced. Problems of using real objects were discussed in Baine (1982) Devore and Stern (1970) discussed in the previous section.

The main advantage of using pictures is to control the discriminative and nondiscriminative features of the objects

presented in the pictures (Baine, 1982). Acquisition can be enhanced by increasing the intensity of the discriminative features while decreasing the number and intensity of nondiscriminative features of photographed objects. As training progresses, a gradual increase in the number and of the nondiscriminative features of the objects to make them more representative of actual objects in the environment will facilitate generalization.

Hillyard (1979) found that learners showed increased generalization to new examples that were not presented in the initial training when the number of discriminative features were held constant and the number of nondiscrminative features in both examples and nonexamples was increased. If the nondiscriminative features are not introduced, Modigliani (1971) found that generalization of learning was greatly reduced. However, more research is needed to determine the relative effects upon generalization of real objects, pictures and photographs.

The "fade-in" procedure has been used in research studies of discrimination learning and generalization. Guralnick (1975); Westling and Koorland (1979) as reported earlier, used the fade-in procedure for discrimination learning. A similar procedure was employed by Koegel and Rincover (1974) for generalization training with 8 autistic children. The subjects were 4.5 to 13 years old. Five of them were untestable and the other three children had IQ of 28, 32 and 38. In the first experiment, the children were

taught basic skills, such as attending, imitation, speech and responding in a one-to-one session. However, Koegel and Rincover found that these behaviors did not generalized to the larger classroom-sized group situation after the initial training. Therefore, during the second experiment a treatment procedure was introduced based upon "fading-in" the classroom stimulus situation by gradually reducing the reinforcement schedule for correct responding and gradually increasing the group size. Such treatment was highly effective in generalizing appropriate verbal and nonverbal behaviors to the classroom. Based on the above research evidence, the fade-in procedure may be a potential component of instructional design in teaching discrimination learning and generalization to the handicapped persons.

Maintenance. Maintenance is referred to as the ability of a learner to maintain an acquired skill after the termination of instruction. It is an important objective of all instruction to ensure that the learner can retain what s/he has learned and apply it in the appropriate situations. As with generalization, maintenance does not occur without programming the environment (Kazdin & Polster, 1973; Stokes & Baer, 1977). If maintenance and generalization are instructional goals, they must be systematically programmed across persons and settings (Stokes & Baer, 1977; Warren, 1977). Sulzer-Azaroff & Mayer (1977) described several techniques for achieving maintainence: "applying schedules of reinforcement, altering reinforcers and fading artifical

prompts to promote the persistence of behaviors under natural enviroment conditions." (p.519). These strategies are discussed in the following section on errorless learning.

Errorless Learning

The present study assumes an errorless approach to discrimination learning. Many mentally handicapped persons experience difficulties in learning. Their ability to learn is often underestimated. For these handicapped learners, acquisition of a new skill is often perceived as another opportunity for failure. They often lack motivation to learn and are unwilling to extend sufficient effort. Lack of sufficient effort increases their learning errors and results in a high failure rate. Errorless learning is an instructional strategy designed to assist handicapped students to learn with a minimum of errors. The principle underlying errorless learning is that if the conditions of instruction are clearly specified and carefully arranged, the learner should be expected to learn without error. Errorless learning is particularly important because once an error has occurred, it is likely that it will recur (McCandless, 1967; Terrace, 1963). Thus, the more errors that are committed, the greater the likelihood of errors and the lower the rate of success in learning new skills. Based on the theory of errorless learning, the instructional conditions and correction procedures should be carefully defined and arranged to minimize the chance of any error, to

maximize the learner's opportunity for success, and to provide more opportunities to reinforce the learner's efforts.

The errorless approach was first demonstrated in Terrace's (1963) experiments with pigeons. The procedure was then used with human subjects, for example, Sidman and Stoddard (1967) used the procedure to study simultaneous form discrimination by mentally handicapped children; Tawney (1972) used an errorless program for teaching four-year-old normal children to discriminate critical and noncritical features of letter-like stimuli. Tawney, Knapp, O'Reilly, Pratt's (1979) programmed environment curriculum for teaching basic skills to severely handicapped persons also employed errorless learning. By using the errorless learning approach, one reflects a positive view of human potential and conviction that no matter how severe the learner's condition is the handicapped person can learn without error.

Errorless instruction uses various techniques of prompting, fading and reinforcement to minimize error. The use of prompts in errorless learning involves: a) directing a learner's attention to the stimulus and improving discrimination learning and/or b) facilitating the performance of a single response or chain of responses. The fading procedure, is used to maintain a high rate of correct responding while transferring stimulus control of the response from the prompt to the discriminative stimulus.

Prompting procedure. A prompt is a supplementary stimulus used to increase the probability of a learner's response in a desired manner. Prompts may serve in two functions. The first function is to assist the learner to perform the learning tasks. The second function is to help a learner to select a stimulus in a difficult discrimination task. The kinds of prompts used to assist a learner to perform a learning task generally involve various levels of assistance that an instructor is required to give to the learner to obtain the desired response. The assistance provided to a learner exists on a continuum ranging from complete physical assistance to no assistance at all. According to Sulzer-Azaroff and Mayer (1977), the hierarchy of prompts can be arranged in the following manner from least to most intrusive: a) verbal, b) gestural, c) modeling and d) physical. The amount of instructional assistance is reduced as a learner progresses from physical to verbal prompts.

Verbal prompts. A verbal prompt is a short verbal phrase used to assist a learner to respond to a task command or other task stimulus. Verbal prompts should be short, precise and consistent. The phrase should be stated slowly and clearly. To be effective, the prompt must be attended to and understood by the learner.

Modeling. If the learner cannot perform the task after being given a verbal prompt, the instructor may demonstrate the correct response to the learner. All or part of the

desired response can be demonstrated and the learner may imitate or repeat the response immediately. Since the learner must see the demonstration in order to imitate, visual-attending and imitative skills are essential. When using modeling, the instructor must first secure the learner's attention to the model. Attention may be gained by pre-teaching the learner to orient appropriately to the signal: "Look at me." or "Look at this". Imitation skills must also be pretaught before using modeling. To be effective, the modeled response or chain of responses should be short and simple. The orientation of the demonstration is critical and the response should be modeled so that the learner does not have to reverse the direction of the demonstration.

Gestural prompts. A gestural prompt is a physical motion made by the instructor to elicit a response if the learner has not responded after a supplemental verbal prompt. The instructor does not come in direct physical contact with the learner. A gestural prompt may include pointing to a task or making a motion with a finger to signal the learner when or how to respond. As with the verbal prompt and modeling, the learner must be paying attention to the gestural prompt. The gestural prompt should be made slowly and consistently each time it is used.

Physical prompts. A physical prompt involves the provision of physical guidance that assists the learner through the task. There are different levels of physical

guidance that can be used. A partial physical prompt may require minimal physical assistance such as gently touching or guiding the learner to respond. A full physical prompt may require total physical guidance to put the learner through the task and may involve the "hand-over-hand" method.

Foxx and Azrin (1975) used a graduated guidance procedure. Initially, a learner was guided with the least amonunt of physical assistance necessary to complete the task. Gradually, the amount of pressure was reduced and the guidance was progressively moved away from the locus of the response. Variations of graduated guidance have been used with mentally handicapped persons in teaching eating (O'Brien & Azrin, 1972; Richman, Sonderby & Kahn, 1980); dressing (Azrin, Schaeffer, & Wesolowski, 1976; Foxx, 1981) and toileting (Foxx & Azrin, 1975).

The prompting system must be carefully matched with the level of a learner's functioning. Variations of using two or three simpler prompts may be employed. Snell (1983) suggested that for those learners who do not respond well to verbal prompts but who do imitate or follow gestural prompts (such as pointing), the following order of prompts may be given: 1) modeling plus verbal prompt, 2) partial physical plus verbal and 3) full physical plus verbal. Kysela et al. (cited in Baine, 1982) used a "test-teach" procedure with moderately to severely handicapped preschoolers. In the test phase, successive levels of prompting that is, verbal,

gestural, modeling, and physical prompts were used cumulatively until the learner reached the level at which s/he was able to perform the task. This procedure was used to establish the least amount of prompting to be used during instruction. The instructor began to teach the learner the task at the least level of prompting at which the learner was able to perform. The instructor decided the type of prompts used and when to move to the next level of prompting. For example, a learner may be required to elicit at least 5 consective correct responses at the level of physical prompting before moving to gestural prompting, the next level in the hierarchy. In this manner, each level of prompting was successively "faded" out until the learner performed the task independently following the task command. The hierarchy of prompts have been used to teach moderately and severely mentally handicapped persons various kinds of skills such as janitorial skills (Cuvo, Leaf, & Borakove, 1978), cooking skills (Johnson & Cuvo, 1981), and sewing and mending (Cronin & Cuvo, 1979).

The second function of prompts is to help the learner to select a stimulus in a difficult discrimination task. This procedure, involves the use of various techniques to increase the saliency of discriminative characteristics of a stimulus. The saliency of discriminative features can be increased by: a) highlighting the discriminative features; b) reducing the saliency of nondiscriminative features and/or c) adding extra or redundant stimuli to draw the

learner's attention to the discriminative features. Various studies reported in the section on discriminative features have employed these techniques (Brown, Shenerman, Cartwright & York, 1973; Lubker, 1969; Meador, 1984; Wolfe & Cuvo, 1978).

Fading procedures. Once the prompt has facilitated the desired response, it should be removed, so that the natural discriminative stimulus can take over stimulus control of the response. This transfer of control from the prompt to the natural discriminative stimulus is achieved by a fading procedure.

As described by Sulzer-Azaroff and Mayer (1977), fading involves "the gradual removal of (usually artificial or intrusive) discriminative stimuli, such as directions and imitative prompts" (p.516). Fading must be done gradually and systematically to maintain the learner's performance. Sudden withdrawal of prompts may destablize a learner's performance. To avoid overdependence, prompts should also be faded as rapidly as possible without excess error or loss of correct responses. Time-delay in the presentation of prompts following a task command allows a learner to anticipate the correct response without asssistance. This technique is effective in teaching severely handicapped learner to follow instructions (Striefel, Wetherby, & Karlan, 1976); to sign (Brower, Morris, & Snell, 1981; Kleinert & Gast, 1982), and to increase language usage (Halle, Marshall, & Spradlin, 1979).

Although there are many types of fading, there are two basic variations. The first type involves fading the level of assistance given by the instructor while the second type involves fading extraneous physical properties that have been added to the discriminative stimuli.

In the first type of fading, the prompts can be faded from one level to the next level of prompting, e.g. from gestural prompt to verbal prompt or within each level of prompting ,e.g. full hands-on physical guidance may be reduced to merely touching a learner's elbow. An excellent example of fading physical prompts is through the previously discussed graduated guidance method.

The second type of fading involves making gradual changes in the physical properties of the discriminative stimulus. This type of fading was demonstrated in Sidman and Stoddard's (1967) study of the effectiveness of fading in programming a simultaneous form discrimination for mentally handicapped children. Their subjects were 19 mentally handicapped boys ages 9 years and 9 months to 14 years and nine months and IQ ranges from 18 to 39. The learning task involved discrimination of a circle from seven ellipses. The experimental group was trained through a fading technique which included background fading and ellipse fading. In background-fading, the correct key always had the circle on a bright background. The incorrect keys were dark at first and gradually become brighter. In the ellipse-fading, the ellipses appeared gradually on the

bright backgrounds of the incorrect keys. The control group was trained without the fading techniques. Seven out of ten experimental subjects learned the task while only one of nine control subjects learned the task.

Fading and nonfading procedures were used by Dorry and Zeaman (1975) to teach a simple reading vocabulary to 36 mentally handicapped children with MA 4.1 to 7.0 years and IQ 23 to 55. The fading group was trained by presenting a word and picture together on the first trial, then on each of five subsequent training trials, the picture was gradually faded, while the word was not. The standard group had the same sequence, but no picture fading. The mixed group received alternating trials of word-and-picture (unfaded) and word-alone. The control group had alternating trials of picture-alone followed by word-alone. Dorry and Zeaman found that the faded condition was most effective followed by the mixed and standard conditions; the control condition was the least effective. With the fading, procedure, the subjects not only differentially attended to the word but also gave enough attention to the faded picture to allow strong associative advantage of the word-picture pairing.

Sulzer-Azaroff and Mayer (1977), reported on a match-to-sample program that was designed by Reese and Werden (1970) using a fading technique to teach number concepts to severely retarded children. Size fading was used to help the children discriminate one numeral from

another. The children learned to match sets of objects on the basis of number. The objects in the sample set and in the correct alternatives were very large, whereas the objects in all the incorrect alternatives were very small. In the initial learning, the children made the correct selection based on size alone. The size of the objects in the incorrect alternatives was gradually increased. By the end of the program, all the objects were the same size and when the size difference was faded out, the children were able to make the correct discrimination based on number alone. This shifting of control from irrelevant to relevant discriminative stimuli by fading can be systematically designed so discriminations can be learned through errorless learning.

Differential reinforcement. The third technique used in the errorless approach is differential reinforcement. The two aspects of differential reinforcement involve:(a) reinforcing appropriate responses only in the presence of certain stimuli and (b) not reinforcing other responses in the presence of the stimuli (Becker, Engelmann & Thomas, 1975). As the appropriate responses are repeatedly reinforced in the presence of specific stimuli, the antecedent stimulus begins to establish control over the response. Eventually, the response will persist in the presence of the stimuli even when the response is no longer reinforced continuously (Sulzer-Azaroff & Mayer, 1977).

Differential reinforcement has been successfully used with mentally handicapped persons in eliminating various maladaptive behaviors (Cavalier & Ferretti, 1980; Luiselli, Colozzi, Helfen & Pollow, 1980; Repp, Deitz & Deitz, 1976); in picture-name training (Olenick & Pear, 1980); in teaching productive noun suffixes (Baer & Guess, 1973) and in teaching instruction following (Kazdin & Erickson, 1975).

Positive reinforcement is used to consequate a correct response. The procedure involves the presentation of a stimulus as a consequence of a response to increase or maintain the response (Sulzer-Azaroff & Mayer, 1977). There are various types of positive reinforcers, such as intrinsic, extrinsic, edible, social, activity, token and tangible reinforcers. For the purpose of the present study, only edible and social reinforcers are discussed.

Social reinforcers such as a smile, visual attention, verbal praise or a pat on the shoulder are naturally occurring consequences that maintain a variety of behaviors in the natural environment. However, social reinforcers may not have sufficient reinforcing value for some handicapped learners. In order to strengthen the reinforcement values of social reinforcer, edible reinforcers are often paired with social reinforcer during initial learning to establish a response. Then, the edible reinforcer is gradually faded out as the social reinforcer begins to maintain the response.

Edible reinforcers. Edible reinforcers such as candies, cookies, and juice are not natural occurring reinforcers and are only used when other consequences do not have sufficient reinforcing values. Edible reinforcers have been used to teach various skills to the mentally handicapped. Hopkins (1968) used candy to reinforce smiling by an 8 years old mentally handicapped boy. Candy was given continuously after each response in the initial training and it was faded out gradually by reinforcing the child intermittently on variable schedules. The social greeting behavior of the child was later maintained under conditions that were natural to his environment. Various studies (Morris & Dolker, 1974; Samaras & Ball, 1975) have used food reinforcement to systematically develop and maintain cooperative behavior among severely and profoundly handicapped persons. Guralnick and Kravik (1973) investigated the relative effectiveness of social and edible reinforcement in developing social behaviors in 8 severely handicapped children ages 6 to 10 years old. They found that edible reinforcement was most effective, but the social behaviors did not generalize from a group to a free-play situation. Although edible reinforcers have been shown to be powerful for developing certain behaviors, it may not be effective in generalizing behaviors to natural situations. It is, therefore, important that reinforcing values of the edible reinforcers should be transferred to more natural

occurring reinforcement such as social reinforcement to maintain behaviors in the natural settings.

Satiation is a problem that may result from the use of edible reinforcers. After consuming a considerable amount of various edibles or the same type of edibles for a long period of time a learner may become satiated and hence the edible reinforcer loses its effectiveness to increase or maintain the desired behavior. To postpone satiation, various kinds of edible reinforcers should be used and only small quantities of food or fluid should be given each time. Intermittent reinforcement is also effective in preventing satiation. Instead of reinforcing the learner on every correct response, s/he is reinforced intermittently. Since the learner cannot predict when the reinforcer is coming, s/he may maintain his/her performance in hope of being reinforced.

Another concern about the use of edible reinforcers is that most of them contain little nutritional value. Sobsey (1983) stated the two potential problems of including carbohydrate-rich reinforcers for the severely handicapped children: (a) undesirable weight gain and (b) nutrient deficiencies when these high carbohydrate foods replace other nutritious foods in a child's diet. Other forms of reinforcers such as social reinforcers, activities, tokens are preferred. For those learners who have not learned to respond to other reinforcers, foods with higher nutritional values should be considered.

Social reinforcers. Social reinforcers are provided by other individuals within a social context. Some common social reinforcers include smiles, verbal praise, a pat on the shoulder and attention. These are naturally occurring reinforcers that maintain a variety of behaviors in the natural environment.

Verbal praise is a positive comment that describes the learner's response that is being reinforced, e.g., "Good looking at the picture." The praise focuses on the specific response or behavior. The learner gets feedback immediately in respect to his/her performance. Heitman and Justin (1980) found that social reinforcement in the form of verbal praise was a significant variable in influencing performance on an accuracy motor task in their educable mentally handicapped subjects who had an internal locus of control, i.e., those who viewed both positive and negative events as consequences of his behaviors and ability, and recognized that they had control over their environment in their failure or success.

Physical contact, such as a handshake, a rub on the chest, and a pat on the shoulder, is particularly reinforcing to learners who have limited receptive language. Johnson and Frankel (1978) successfully used physical contact as a sole reinforcer for behavior modification training for 2 mentally handicapped boys (ages between 3 and 10 years old). Kadzin and Klock (1973) increased attentive

behavior of eleven of twelve mentally handicapped school children by using contingent smiles, patting, and touching.

There are several advantages to using social over other types of reinforcers. Social reinforcers can be dispensed immediately each time a desired response occurs. There is less tendency for the learner to be satiated with social reinforcers. Social reinforcers are natural in social settings and, therefore, they do not have to be faded out as other artificial reinforcers do in a training program (Sulzer-Azaroff & Mayer, 1977).

Baine (1982) suggested the following guidelines for effective use of reinforcers:

1. Reinforcement should immediately follow the desired response so that the learner can identify and repeat the response that is being reinforced.
2. During initial training, the desired response should be reinforced continuously to build up the relationship between the learner's response and the reinforcement. If continuous reinforcement is not possible for every response, descriptive praise may be used in conjunction with other types of reinforcers.
3. Intermittent reinforcement should be used to maintain a response after the learner has developed competency in responding. This schedule avoids the satiation effect.
4. Shifting from continuous to intermittent

reinforcement should be carefully planned so as to maintain the learner's response level.

5. The type, amount, and frequency of reinforcers and the exact nature of response to be reinforced should be analysed. Reinforcement within the training environment should be congruent with reinforcment available in the natural settings.
6. The amount and types of reinforcer to be used for different level of task difficulty should be determined. The instructor should avoid increasing reinforcement after a learner has encountered a learning problem. This procedure may teach the learner to exhibit difficulty so that s/he can obtain more reinforcement.
7. Reinforcement should be made available only following the occurance of a desired response.
8. Reinforcement should be given for appropriate behaviors such as attending to task, persevering in difficult trials, increasing effort, and also absence of inappropriate behaviors, e.g., off-task, disruptive behaviors.
9. Desirable activities should be made contingent upon the completion of less desired behaviors.
10. No reinforcement should be dispensed during pre- or post-tests for these tests are used to assess the learner's ability to perform without assistance.

Correction procedure. A learner may occasionally respond incorrectly under the errorless approach. When an error is made, some type of correction must be provided. As mentioned earlier, once a learner makes an error, it is likely that the error will recur (McCandless, 1967; Terrace, 1963). Generally, it is better to correct the error than simply to ignore it (Denny, 1966) to decrease the likelihood of recurrence of the error.

Various correction procedures have been used to correct errors. Snell (1983) discussed three correction methods. One method is to repeat the discriminative stimulus immediately and provide another opportunity for the learner to perform with an increase amount of assistance. The second method is to intercept the error response before completion and provide the minimum amount of assistance to elicit a correct resonse. The discriminative stimulus is not repeated. The third method is to intercept the error and follow it immediately with a verbal prompt plus physical assistance and repeated practice. This physically assisted repeated practice has been found to be more effective than a single verbal-physical prompt or a verbal-gestural correction (Close, Irwin, Prehm & Taylor, 1978). Repeated practice requires a learner to practise the correct response a number of times. A similar correction procedure was recommended by Sulzer-Arazoff and Mayer (1977). They recommended that a learner practice the correct response several times before a new trial is presented. This

procedure would provide the learner more chances for success before proceeding and more opportunities to establish an appropriate stimulus response relationship. There are a few basic rules to follow in using correction procedures effectively. Snell (1983) suggested that correction procedures must:

1. be matched to the learner's present level of functioning;
2. be applied immediately and consistently;
3. provide enough assistance to correct the error quickly;
4. be matched with the amount of assistance and the level of performance that he requires to accomplish the task;
5. be followed by additional opportunities to respond on the same task.

Single-Subject Research Design

Over the past decade, there has been an increasing number of research studies that have employed single-subject research designs to study the effects of experimental intervention on mentally handicapped persons. The main characteristic of the single-subject design is that both experimental and control conditions are applied to the same subject, and the results of a change in behavior are analyzed with respect to changes in the individual's performance during various phases of intervention. Some of the common purposes of the single-subject designs are, as Bailey (1978) indicated, (a) solving problems, (b)

demonstrating the effectiveness of a particular set of procedures, (c) comparing several procedures with each other, (d) providing a parametic analysis, and (e) analyzing parts of a package of effective procedures. Several advantages to the single-subject designs have been described in the research literature (Hersen & Barlow, 1976; Kadzin, 1982; Kadzin, 1978; Tracey, 1983; Ulman & Sulzer-Azaroff, 1975). A major advantage over group research designs is that conclusions can be drawn about an individual's performance because each individual subject's behavior is measured across time and conditions. The relationship between a specific intervention and a change in an individual's behavior can be detected. Thus, objective feedback may be obtained about the subject, together with the effectiveness of a particular intervention. Data collected repeatedly from an individual over time are more reliable and valid than assessments done in a single session as is the case with group designs. Since each individual is exposed to all the conditions of the study, there will be fewer problems with internal validity than in the group design.

There are four basic single-subject research designs: reversal (ABAB), and its variations, multiple-baseline, changing-criterion, and multielement (or multi-treatment) designs (Kazdin, 1982). The reversal and multi-baseline designs are the two most common single-subject designs (Kadzin, 1978).

Reversal (ABAB) designs and their variations have two basic components: the baseline procedures (A) when no intervention is in effect and the treatment conditions (B). The effect of treatment is examined by alternating the baseline phase with the treatment phase. The effects of the treatment are demonstrated when improvement in performance is shown during the two treatment phases, and when performance reverts to the baseline level during the two baseline phases.

One of the problems with these designs is the irreversibility of behavior. It is sometimes impossible for some behaviors established by the treatment to reverse to the baseline levels following withdrawal of the treatment (Cuvo, 1979). Many learned behaviors, such as reading and attending skills are irreversible. Another concern associated with the reversed design is the ethical problem and staff resistence to returning to the baseline level. It is unethical to withdraw treatment especially when it has been found to be effective. It may also be difficult to convince staff to withdraw treatment, e.g., giving praise to the subject, or to alter their behavior, e.g., stop praising, to reinstate the baseline procedures (Kadzin, 1982). These problems limit the use of reversal designs in instructional research.

The multiple-baseline design is an attractive alternative to the reversal designs. It does not require the behavior to be returned to the baseline level and the

effect of treatment can be examined across several behaviors of the same individual, across the same behavior of a number of individuals, or across a number of settings. In this design, two or more behaviors are measured simultaneously, before the treatment is introduced. After the performance is stable for each of the behaviors, the treatment condition is applied sequentially to either one behavior, one environment, or one individual at a time. The rationale for the design is to show that behavior changes when the treatment is being applied. The behaviors that are not treated should remain at baseline levels (Kadzin, 1982).

There are a few limitations in applying the multiple-baseline design to the instructional setting. There may be interdependence of behaviors in which the treatment effect is carried over from baseline to another "untreated" baseline. The multiple-baseline design assumes that all the measured behaviors are susceptible to the same variables (Ulman & Sulzer-Azaroff, 1975). However, the treatment effects may be inconsistent in that improvement is shown in some behaviors but not in others. The problem of prolonged baselines raises an ethical consideration as intervention is withheld from each baseline for a certain period of time (Kadzin, 1982). Recording two or more behaviors throughout the experiment may not be practical in an applied settings.

The changing-criterion design requires a baseline to be established for a particular behavior under study. Before

the treatment condition is implemented, a new criterion for the behavior is established; following the initial treatment a successively higher or lower criterion, as desired, is established. Criterion changes are introduced from one phase to the next as the behavior meets each criterion. The purpose of the design is to show that behavior changes when the criterion changes. The design does not require withholding of treatment or reversal to the baseline. Kadzin (1982) discussed some of the difficulties in using the changing-criterion design. In the intervention phase, behavior is expected to change in response to different criteria. When there is no correspondence between the criterion and the behavior, it is difficult to infer that the behavior change is caused by the treatment. The changing-criterion design relies on a gradual change in performance as the criterion for the behavior is gradually increased or decreased. When there is a rapid change in behavior that exceeds the criterion, it may be hard to assess the treatment effects. The number of criterion shifts is important to determine the treatment effects. Too small or too large a number of times that the criterion is changed may not show clear treatment effects. The same problem may occur when deciding on the magnitude of criterion shifts, i.e., the amount of change made in the criterion over the course of treatment.

The single-subject designs that have been discussed all have their own merits and limitations for use in

instructional application. The choice of design to be used in a specific application is determined by the research problem, the behavior under study, the attitudes of teachers and school personnel, and the ease of application of the design in the classroom settings (McLaughlin, 1983).

A very useful single-subject design for comparing instructional methods and materials is the multielement (or multiple-treatment) design (Barlow & Hayes, 1979; Kadzin, 1982; Sidman, 1960; Ulman & Sulzer-Azaroff, 1975). The multielement design involves repeated measurement of a behavior under alternating types of treatments. The treatment effects can be assessed by comparing each subject under each type of treatment. There are several advantages to using the multielement design for instructional evaluation. The design does not require reversal of behavior and therefore, can be applied to a variety of behaviors that are irreversible. The research can be terminated as soon as the treatment effect is demonstrated. If the research has to be stopped prematurely, the collected data can still provide valuable evidence for future study. The multielement design avoids the problem of prolonged and unstable baseline which is a major concern for the other single subject designs. Comparisions can still be made between treatments even with an unstable baseline (Sidman, 1960). The design may be more acceptable to school personnel as it does not involve withholding treatment or reversing to the baseline conditions. The design permits

the analysis of the effects of a larger number of treatments within a given time than is possible with the other single-subject designs. It can be used for assessing generalizations, across behaviors, settings, and trainers (Ulman & Sulzer-Azaroff, 1975).

There are two major problems in using the multielement designs. They are the sequential effect and contrast effect (Ulman & Sulzer-Azaroff, 1975). The sequential effect occurs when the treatment in one phase is confounded by the effects of the previous treatment. Sequential effect can be controlled by counterbalancing the treatments. This is done by rapidly alternating the treatments and presenting each treatment briefly. The contrast effect is caused by the influence of one treatment on the next treatment, regardless of the sequence. This can be controlled by counterbalancing the order of treatments and by presenting only one treatment per session.

Some research studies have successfully demonstrated the use of the multielement design with mentally handicapped students in investigating different variables in classroom token systems (Repp, Klett, Sosebee & Speir, 1975); in comparing the effects of group and individual reinforcement contingnecies on the academic behaviors of retarded adults (Ulman, & Sulzer-Azaroff, 1975); in increasing upright head positioning with profoundly retarded adolescents (Murphy, Doughty & Nunes, 1979); and in assessing the effects of interspersing known words with unknown words in a reading

acquisition task with mentally handicapped adolescents (Neef, Iwata & Page, 1978). The advantages of multielement design over the other single-subject designs and the successful implementation of the design to the learning situations demonstrates that the multielement design offers an evaluation alternative in instructional research.

Chapter III

STATEMENT OF THE PROBLEM

Problem

There are two controversial issues in using pictures to teach concepts to severely handicapped learners. Both issues are related to the two processes of concept learning: discrimination and generalization. The first issue is how can pictures be used to facilitate discrimination learning; and the second issue is how can they be used to enhance generalization?

Discrimination learning involves disguishing (a) the discriminative features from the nondiscriminative features of stimuli given positive and negative examples of the concept, and (b) distinguishing the discriminative features of the concept being taught from these of other concepts (Becker, Engelmann & Thomas, 1975). In concept acquisition, a severely handicapped person must learn to attend to the relevant dimension of the concept and select the correct cue of that dimension (Zeaman & House, 1963) in order to identify the discriminative features and distinguish them from the nondiscriminative features of the concept.

To increase the ease of concept acquisition, systematic control in the presentation of discriminative and nondiscriminative features of stimuli can enhance a learner's performance. Increasing the salience of discriminative features and reducing the number and salience

of nondiscriminative feature in initial instruction directs a learner's attention to the discriminative features and reduces distraction of nondiscriminative features.

When color and background are nondiscriminative features of the concept, their inclusion in pictures that are used to teach concrete concepts to handicapped learners may impede the rate of concept acquisition. Color and background may distract the learner's attention from the relevant dimension of the concept being taught. When such nondiscriminative features are controlled, such as by using black and white photographs without background during initial instruction, the rate of concept acquisition may be enhanced.

Holding the nondiscriminative features of the concept constant while increasing the salience of the discriminative features may facilitate discrimination learning of the concept but may also reduce generalization. Research (Hillyard, 1979; Modigliani, 1971) has indicated that when the nondiscriminative features are not introduced and varied during instruction, generalization of learning is reduced.

One can argue that "simplified" pictures such as black and white photographs in the acquisition phase does not resemble or approximate the life-like representation of the concept (Guess, Sailor & Baer, 1976). There are more nondiscriminative and discriminative stimuli in the learner's environment than the picture may represent. Thus, the learner may fail to generalize that the picture

represents various different exemplars of the concept in the natural environment. Furthermore, it is possible that some learners may not have learned that two dimensional pictures represent three dimensional objects. It is for these reasons that instructional developers such as Guess, Sailor and Baer (1976) have strongly discouraged the use of pictures with severely handicapped learners and have recommended the use of real objects.

If following initial instruction, there is a systematic and gradual introduction of nondiscriminative features (e.g. color and background) into the "simplified" pictures (e.g. black and white photographs), then the learner may initially acquire the concept faster without distraction and also learn to generalize as the nondiscriminative features are introduced.

It is the purpose of this study to investigate the effect of black and white photographs without background; color photographs with full background (i.e. nondiscriminative features) and a fade-in color and background condition in which the color and background are gradually faded in to the black and white photographs following initial instruction. The effects upon the rate of concept acquisition, generalization and maintenance will be studied.

Acquisition

Research Question Ia. What is the effect of black and white photographs without background on concept acquisition, generalization and maintenance?

Hypotheis Ia. There will be a faster rate of concept acquisition with fewer trials to criterion in the condition in which black and white photographs with no background are used in training than in the condition where color photographs with background are employed.

Rationale. Black and white photographs with no background have less distraction than photographs with color and background, therefore, there will be a faster rate of acquisition with fewer trials to criterion.

Research Question Ib. What is the effect of color and background on concept acquisition?

Hypothesis Ib. Compared to the conditions in which black and white photographs without background are used during training, there will be a slower rate of acquisition with an increase in the number of trials to criterion when color photographs with background are used in training.

Rationale. The rationale is that the color and background are nondiscriminative features that will distract the learner and decrease the rate of acquisition but will increase generalization.

Research Question Ic. What is the effect upon concept acquisition and generalization of using black and white photographs without background during initial training while

fading in color and background during the final stage of instruction?

Hypothesis Ic. There will be an equal or slower rate of acquisition, i.e., more trials to criterion in the fade-in color and background condition than there would be in the condition in which black and white photographs without background were used; there would be an equal or faster rate of acquisition, i.e., less trials to criterion than in the condition in which color photographs with background were employed.

Rationale. Without the distracting nondiscriminative features of color and background in the initial stage of training, it will be easier for the learner to identify the concept and the rate of acquisition will be enhanced. Generalization will also be improved as the nondiscriminative features are gradually introduced to train the learner to identify common variations of the concept being taught.

Generalization

Research Question II. What is the effect upon generalization of using black and white photographs without background; color photographs with background and with fade-in color and background photographs?

Hypothesis II. There will be fewer correct responses in the generalization tests in training with black and white photographs than in training with color photographs with

background and in the fade-in condition in which color and background are eventually introduced into the photographs.

Rationale. The rationale is that the "simplified" black and white photographs without background do not represent the various different exemplars of the object in the natural environment and therefore, generalization will be reduced. With color and background and the gradual fade-in of color and background, the photographs will more closely resemble the real-life representation of the objects and generalization will be enhanced.

Research Question on Maintenance. What is the effect of training with black and white photographs without background; color photographs with background and fade-in color and background photographs on maintenance? No hypothesis is formulated on maintenance but it is the intention of the present study to examine the effectiveness of the three training conditions on maintenance.

Chapter IV

METHOD

Subjects

Three dependent handicapped boys served as subjects in the study. They were attending the Alberta Association for the Dependent Handicapped Summer Program from 9 July to 24 August, 1984, while the present study was undertaken. During the regular school year, they were enrolled in classes for dependent handicapped students.

The students were classified as dependent handicapped under the definition employed by the Edmonton Public School System. The subjects were mentally handicapped at a severe/profound level (I.Q. approximately 30 or less). Their ages were: 6 years; 7 years 1 month; and 11 years 9 months, respectively.

The students were selected for the study based on the following criteria that they met during the pre-tests described more fully later in this chapter. The subjects could (a) physically attend to a task by touching the requested object within 5 seconds of a command in 3 consecutive trials in 5 minute sessions; (b) look at an object for 2 seconds; (c) move their eyes and follow movement of an object when the instructor moved the object for 8 seconds; (d) visually attend to a task for 10 seconds and (e) match-to-sample some colored blocks (green/blue/red). They all required the same level of

minimum physical assistance in tracing and following line from left to right with the preferred index finger.

Subject 1 was 6 years old. He has cerebral palsy and walked with a special stroller. No other physical or visual deficit was present. He responded to his name and responded to Yes/No appropriately. He could identify requested pictures by pointing to them. He babbled and cried. He was learning to use a combination of simple manual sign and symbols for communication at the summer program.

Subject 2 was 7 years 1 month old. He had no physical handicap and walked independently. His near-sightedness was corrected by wearing eyeglasses. There was no other gross physical or sensory deficit. He could follow simple one-step directions, for example, "Come here" and identify by pointing to the requested pictures. He vocalized and attempted to communicate with speech. He was learning to communicate with a combination of pictures and manual signing at the summer program.

Subject 3 was 11 years 9 months old. He had no physical or visual deficit. He used two-word phrases and imitated vocalizations, but his speech was not clear. In the past, he had tried manual signing for communication.

Setting

The instruction was conducted in a small therapy room in a school setting for most of the study until the summer program ended. Subject 1 finished all instruction in the school. Two generalization tests and maintenance tests were

done in his home setting. Part of the instruction and all of the testing were conducted in the respective homes of subjects 2's and 3's after the end of the summer program.

Materials

Photographs. There were 3 sets of 3 photographs for a total of 9 photographs. The first set of 3 photographs was in black and white with no background (B/W condition). The second set was of 3 full color and background photographs (color condition). The third set was 3 half color with half background photographs (F/C condition). In each case, the size of the photographs was 9.5 x 9.5 cms. They were taken under the following guidelines:

1. The objects were completely shown in the photograph.
2. The object covered most of the area of the photograph.
3. The object was photographed at an angle that focussed on the discriminative feature of the object.
4. The picture of the object was taken at a natural angle of observation.
5. The pictures were taken so that no glare or reflections from light sources fell on the objects.
6. There were no extraneous shadows in the photographs except when they were essential to reveal the contour of the objects.
7. The arrangement of the objects and the angle at which they were photographed were identical in both the color and black and white photographs. The only difference was in the color and the background.

8. All photographs were printed on a matt finish.
9. Background:
   i. there was only a white background for the black and white photographs.
   ii. there was a red and blue floral print with repeated pattern behind and under the object for the full color photographs.
   iii. there was a light cream colored tablecloth with a repeating blue floral pattern behind and under the object for the half color photographs. The pattern was approximately half as prevalent in this condition as in the previous condition.
10. The half color photographs were printed with 20% of the color being washed out during the developing process.

Object selection. The nine objects that were selected for the study were: (a) an iron, (b) an emergency lantern, (c) a spray can, (d) a grinder, (e) a blender, (f) a sander, (g) a fishing reel, (h) a watering can and (i) a hand mixer. Their selection was based on the following guidelines:

1. Each object had a discriminative feature that could be distinguished from the discriminative features of the other selected objects.
2. Each object was available in a variety of different colors which could be used for generalization tests.
3. All objects had the same amount of color saturation so that the brightness of the colors would not be a cue to the subject.

4. The objects had similar amounts of complexity in their extraneous features, such as the surface pattern. In order to balance the complexity among the objects, a few changes were made on some of the objects. Decorative strips were added on the side of the iron. The floral design on the watering can was painted. The nozzle of the spray can was painted black to increase the salience of the discriminative feature. Orange colored water was put into the container of the blender.
5. All the selected objects were functional but unfamilar to the subjects.
6. All objects could be easily transported and photographed.

The name of each object used in the task command of the instructional procedure was restricted to a one-word label. For example, the name of the watering can used for the task command was "can". This approach to labelling was employed to minimize the difference in the difficulty of learning the label in association with the objects. The name for each object used in this study was as follows:

iron - "iron"

emergency lantern - "light"

spray can - "spray"

meat grinder - "grinder"

blender - "blender"

sander - "sander"

fishing reel - "reel"

watering can - "can"

hand mixer - "mixer"

Choice of discriminative feature. The subject identified each object by tracing the discriminative feature of that object. The criteria for choosing the discriminative features were:

1. the discriminative feature of the object must be the unique and distinctive part of the object.
2. its discriminative feature must be easily distinguished from that of the other objects.
3. the shape of the discriminative feature must be easy for the subject to trace.

The discriminative feature of each object and the rationale for choosing a particular feature as an discriminative feature for each object is discussed below.

Iron: the handle was chosen as the discriminative feature of the iron. Although the handle was not a universal discriminative feature for the iron, it was a distinctive feature compared to the other objects that were used. The base of the iron would have been chosen had it not born a resemblence to the base of the sander.

Light: since the spotlight was the main feature of the emergency lantern, the rim of the spotlight was chosen as the discriminative feature.

Spray: the nozzle on the top of the spray can was selected as the main feature of the can.

Grinder: the handle was chosen as the discriminative feature.

Blender: the row of buttons on the blender were a unique feature different from those of the other objects.

Sander: the base of the sander was chosen as the discriminative feature because it was the functional and distinctive part of the sander.

Reel: the crank of the reel was selected as the discriminative feature as it looked different from the features of the other objects.

Can: the spout was identified as the discriminative feature of the watering can as its long and slender shape was easily distinguished from the shape of other objects.

Mixer: the beaters were chosen as the discriminative feature of the mixer because of their uniqueness.

Tracing the discriminative features. The response required to identify the object was to have the subject trace the discriminative feature of the requested object. Although tracing is not a common technique in responding, it can ensure that the learner has paid attention to the

discriminative features before he responded correctly. Responding by pointing, a common physical response in discrimination learning, can be problematic as a learner can point to the photographs without having to pay attention to its discriminative features. Tracing may eliminate the problem that Dixon (1981) had with her severely handicapped subjects who attended to the rectangular edge and flatness of the photographs (nondiscriminative features) rather than to the actual figures (discriminative features). By using tracing, the learner was required to attend to the discriminative features of the concept in the photographs. Tracing the discriminative feature of the objects involved tracing:

1. straight line from left to right, as for:
   - I. the handle of the iron
   - II. the base of the sander
   - III. the buttons of the blender
   - IV. the handle of the grinder
2. slanting line from left to right, as for:
   - I. the beaters of the hand mixer
   - II. the crank of the fishing reel
   - III. the spout of the watering can
3. curve line from top to bottom, as for:
   - I. the rim of the spotlight on the emergency lantern

All these lines are no more than 5 cms. in length. To identify the spray can, the subject was required to point to the spray can's nozzle. When comparing the relative

difficulty of responses, it is apparent that pointing to the nozzle of the spray can was the easiest response while tracing the rim of the spotlight was the most difficult one because of the curved line. Tracing objects with horizontal, vertical or slanting lines are of the same relative difficulty. The subject was required to trace along the right side of the line. The subject's forefinger must remain no more than 0.5 cm. from the discriminative feature of the object that he was tracing. By tracing from left to right or top to bottom along the lines, the subject's forefinger would not interfere with the visibility of the discriminative feature that was being traced.

Pretests

The subjects who participated in this study were pretested to assess their entry level skills required for the research. These skills were determined by the following pretests which were operationally defined in the form of behavioral objectives that assess the attending, sensory, motor and communication skills of the subjects.

Pretest 1

Attending skill:

1. physically attends to task by sitting for training for a minimum of 5 minutes.

Given:

1. 3 familiar objects, placed in front of the subject, on the table, about 20 cms. away and within the range of vision and reach of the subject.

2. task command: "Touch (object), (subject's name)."

Subject will:

1. physically attend to the task by touching the object upon request, within 5 secs. of the given task command in 3 consecutive trials in a 5 min. session.
2. sit through the training for a minimum of 5 minutes.

Pretest 2

Attending skill:

1. makes eye contact and visually follow the movement of the visual stimulus for 10 secs.

Given:

1. a picture or object, such as a toy, placed directly at his eye level, 24-30 cms. away.
2. a task command: "Look, (name of subject)."
3. instructor moves object to the sides, upward and downward within subject's range of vision.

Subject will:

1. look at the object for 2 secs.
2. move his eyes and follows the movement of object when the instructor moves object for 8 secs.

Criterion:

3 consecutive correct trials within a 5 min. session.

Pretest 3

Motor skill:

1. fine motor finger control.

Visual skill:

1. visually attends to task by watching what he is doing for a maximum of 10 secs.

Given:

1. one of the 3 tracing patterns (as described and shown below), placed on the table, in front of subject about 8 cms. away.
2. instructor models and gives task command: "Trace, (name of subject)" simultaneously.

Subject will:

1. visually attends to task by watching what he is doing for a maximum of 10 secs.
2. places finger on the line.
3. traces and follows line from left to right with his finger.

Instructor assesses the level of performance of subject:

level 0 - instructor's model and complete physical guidance

level 1 - instructor's model and minimum physical guidance

level 2 - instructor's gestural prompt

level 3 - no asistance

There were three tracing patterns as shown in Figures 1a, 1b, and 1c.

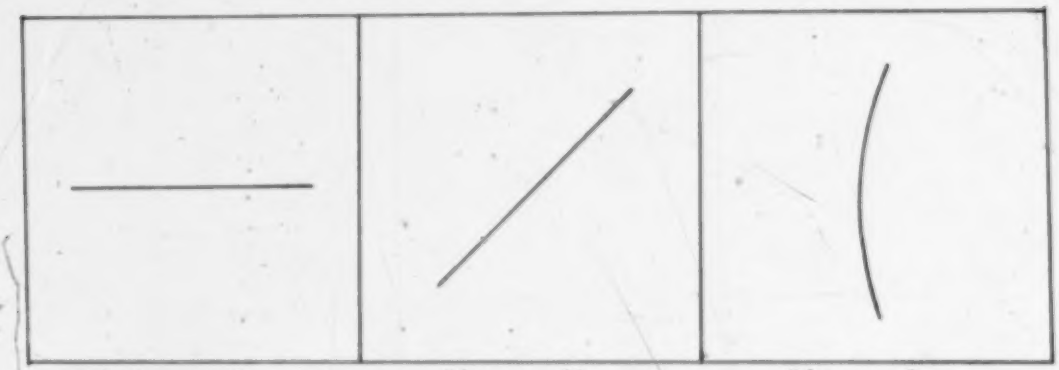


Figure 1a.
A straight line

Figure 1b.
A slanting line

Figure 1c.
A curve line

1. each pattern is drawn with a red felt pen on light green card (approximately 10 x 10 cms.).
2. the thickness of the line is no more than 0.5 cm.
3. the length of the lines is no more than 10 cms.
4. tracing always started from left to right with the straight lines and top to bottom with the curve line.

Pretest 4

Visual Discrimination:

1. matching color.
2. visually scans an array of objects for a desired item.

Given:

1. an array of 3 colored blocks (green, blue and red) in front of the subject.
2. a sample of one of the 3 colored blocks.
3. instructor's task command "Match (name of color)."
4. positions of color blocks randomized.

Subject will:

1. touch the colored block to match the sample.

Criterion:

3 out of 3 consecutive trials for each color matching in a 5 min. session.

Experimental Design

Experimental conditions. The multielement single-subject design was used for this study. This design involved comparing treatment conditions by alternating them over time and measuring the effects of the conditions on each subject's performance.

The independent and dependent variables are as follow:

Independent variables:

Condition B/W: training with black and white photographs having no background.

Condition COL: training with photographs having color and background.

Condition F/C: initially training with black and white photographs having no background and fading-in half color and half background photographs and finally, fading-in full color and full background photographs at the later stages of training.

Dependent variables:

1. Rate of acquisition measured by the number of trials to criterion in each condition.

2. Amount of generalization measured by the number of correct responses in the generalization tests after the criteria of all the experimental conditions are reached.
3. Amount of maintenance measured by the number of correct responses in the maintenance test in each condition.

In this study, three treatment conditions were alternated with each subject. In the first experimental condition, the black and white photographs without background were used throughout the training. Full color photographs with background were used in the second experimental condition. In the third treatment of "fade-in color" condition, the nondiscriminative features (color and background) were gradually faded-in by using 2 sets of photographs : (a) half color and half background, and (b) full color and full background photographs. This strategy is similar to Strokes and Baer's discussion of "programming common stimuli" which includes stimulus features that change between different photographs and represents stimulus features of objects, such as color and background to which the photograph is to be generalized.

For the third experimental condition, black and white photographs without background were used in the initial training until the subject reached the criterion of prompt level 1 (minimal physical guidance). A set of half color with half background photographs were introduced and replaced the black and white ones. This set of photographs was used until the criterion of prompt level 2 (gestural

prompt) was reached. Then, the full color photographs were introduced until the subject reached the criterion of level 3 (without assistance).

When the photograph of object 2 was introduced, the photograph of object 1 was put on review. Since the black and white photograph of object 2 was used for the initial training, the black and white photograph of object 1 was used for review, instead of its full color photograph that was used for reaching the criterion of level 3 in the last stage of learning. The rationale of reintroducing the black and white photograph of object 1 for review was that the subject would learn to discriminate the two photographs of objects 1 and 2, based on the difference in the discriminative features of the objects and not due to the nondiscriminative differences in the two photographs.

The half color and full color photographs of object 1 were respectively paired with those of the object 2 for review in the later stage of learning object 2. The same was applied to object 1 and 2 when they were put on review while the subject was learning to identify object 3. In this case, all the photographs presented together for discrimination had the same color and background.

During the day, each subject was taught individually under three experimental conditions in three separate sessions. Each 5 min. session was approximately one and half hours apart. Each session included 10 training trials and, if applicable, five additional review trials for each

photographed object learned. The presentation of a short session for each condition was to minimize the possible sequence effects as evidence has been shown that the longer the subject is exposed to one condition, the greater was the carry-over effects on the subsequent condition. (O'Brien, 1968).

The order of the three experimental conditions to be taught were randomized and counterbalanced so that each condition was followed equally often by every other condition. There were six possible sequences of the three experimental conditions in which the order of conditions was counterbalanced so that each condition was followed equally often by every other condition.

Sequences:

1	2	3	4	5	6
B/W	COL	F/C	COL	B/W	F/C
COL	B/W	COL	F/C	F/C	B/W
F/C	F/C	B/W	B/W	COL	COL

B/W = black and white photograph with no background condition

COL = full color photograph with background condition

F/C = fade in color photograph with background condition

Each subject was randomly assigned to one of the six sequences each day. A sequence was randomly selected for a subject by drawing without replacement from the six

sequences. After the completion of six sequences, they were redrawn again till the end of the research. This arrangement was to minimize any sequence effects on the subjects.

Assignment of objects into three experimental conditions. The nine objects were randomly assigned to the three treatment groups. Each group of objects was randomly assigned to each condition for subject 1. For subject 2 and 3, each group of objects was assigned to each condition and subjects in such a way that each group of objects would be under three different conditions among different subjects. For example, if objects 1, 2 and 3 were randomly selected for subject 1 under Condition B/W, then these objects 1, 2 and 3 were randomly assigned either for subject 2 or 3 in either Condition COL or Condition F/C, so that object 1, 2 and 3 would be used in different conditions among three different subjects.

Example :

Assignment of objects into three experimental conditions:

Subject	Condition B/W	Condition COLOR	Condition F/C
1	Object 1, 2, 3	Object 4, 5, 6	Object 7, 8, 9
2	Object 4, 5, 6	Object 7, 8, 9	Object 1, 2, 3
3	Object 7, 8, 9	Object 1, 2, 3	Object 4, 5, 6

Table 1 shows the actual objects that were taught to subject 1, 2, 3 under 3 conditions.

Table 1

Objects that were taught to the 3 subjects under 3 different co nditions

Conditions	Subject 1	Subject 2	Subject 3
B/W	Blender	Iron	Spray
	Reel	Sander	Can
	Light	Grinder	Mixer
COL	Iron	Spray	Blender
	Sander	Can	Reel
	Grinder	Mixer	Light
F/C	Spray	Blender	Iron
	Can	Reel	Sander
	Mixer	Light	Grinder

Experimental procedure. The instructor began training by teaching the subject to trace and identify object 1 to criterion. Then object 2 was added and was taught in combination with object 1 on review. When the subject had reached criterion on object 2, object 3 was introduced and was taught to criterion in combination with the other 2 objects on review. When subject had reached criterion on object 3, he was given the generalization test.
All conditions were identical except for the differences in the independent variables, i.e., differences in the color and background of the photographs. The number of trials for all three experimental conditions for each subject was held constant. The rationale for holding the number of trials constant was to show that any difference on the amount of generalization was due to the effect of the different experimental conditions and not due to differences in the number of trials to criterion in the conditions.

In order to hold the number of trials constant for all three experimental conditions within each subject, the subject continued to practise or overlearn under the same experimental condition with the same number of trials given to the other two conditions. The overlearning for the two conditions continued until the criterion of the last experimental condition was reached.

Data collection. Daily data were collected in each training session. The performance of the subject in each

trial was recorded according to the level of physical guidance and prompting that were given by the instructor.

Level of guidance and prompting are as follows:

level 0 - Instructor models and gives verbal prompt and complete physical guidance, i.e., instructor guides the subject by hand-over-hand method through the tracing of the discriminative feature of the object being taught.

level 1 - Instructor models and gives verbal prompt and minimal physical guidance, i.e., the instructor lightly touches the forefinger of the subject with her thumb and forefinger and physically guides the subject's finger through the tracing.

level 2 - Instructor gives gestural prompt by pointing the subject to trace.

level 3 - Instructor gives no assistance but only the task command.

The subject had to complete 5 consecutive correct trials at each level of guidance or prompting before proceeding to the next level of prompting which required less assistance. A response was correct when the learner traced the discriminative feature of the object requested at his present level of prompting or with less prompting or guidance that he was capable of. The subject's forefinger should be no more than 0.5 cm. away from the discriminative feature of the requested object he was tracing.

If the subject made an incorrect response at any level of guidance or prompting, the instructor carried out the correction procedure and continued the same level of guidance or prompting for another 5 trials. The rationale for continuing the same level of guidance or prompting was that the incorrect response might be a chance error that the subject had made. However, if the subject made 2 consecutive errors out of the 1st 3 trials when a new level of guidance and prompting was introduced, the instructor dropped back to the previous level of guidance or prompting. The instructor reintroduced the previous level of guidance or prompting when the subject made 3 or more consecutive errors. The rationale for reintroducing the previous level of guidance or prompting was that the subject's 2 or more consecutive errors might indicate that the subject failed to learn at that level of guidance or prompting and might require more practice at the previous level. An incorrect response is marked as (X) on the data sheet. An (X) also represented resistance to response, making wrong responses, no response, and not attending to task, etc.. The number of consecutive trials at the highest level of prompting in each session was recorded and graphed daily.

Reinforcement procedure. Correct responses were socially reinforced with descriptive praises, such as "Good attending to the photographs." The verbal praise was also paired with the physical reinforcement, such as rubbing on his back or a pat on the shoulder.

Edible reinforcers, such as smarties or popcorn, was delivered intermittently over sessions following correct responses. Three edible reinforcers were given within a 10-trial session. They were given at approximately the 3rd, 6th and 10th trials following correct responses. Edible reinforcement were interspersed in the trials so that the subject would not become satiated with it.

Correction procedure. When the subject made an error, the instructor said firmly: "No, (name of subject), trace (name of object)." Then instructor physically guided the subject's preferred index finger to trace the discriminative feature of the photographed object requested three times. This procedure was similar to the physically assisted, repeated practice suggested by Sulzer-Arazoff and Meyer (1977) to provide the learner more opportunities to establish an appropriate stimulus response relationship.

Training Procedure for Object 1

1. The instructor held up the photograph of object 1 in front of the subject, 24-30 cms. away and at the eye level of the subject.
2. The instructor gave a readiness signal by saying: "Name of subject, (1 sec. pause) look." (Rationale for the pause is to give the subject the time to focus his attention and prepare for his response). The readiness signal was gradually faded out as the subject learned to attend to the photograph.

3. The instructor placed the photograph on the table about 20 cms. away and within the range of vision and reach of the subject. In the initial training, the instructor moved the photograph slowly to the table, taking about 3 secs. after the readiness signal. The slow movement was to provide the subject with enough time to look at the photograph and slowly follow the placement of the photograph with his eye movement. In the subsequent training, the instructor sped up the movement of the photograph to 1 sec. after the subject became more proficient in focusing his attention.
4. The instructor checked the subject's eyes to determine if he was looking at the photograph and following its placement on the table.
5. If the subject was not looking, the instructor physically guided the subject's head toward the direction of the photograph and repeated the readiness signal together with a gestural prompt by pointing to the photograph. The instructor gradually faded-out the physical guidance to a gestural prompt and a readiness signal. Then the gestural prompt was faded-out to only a readiness signal. The readiness signal was gradually faded-out when the subject could direct his attention without any prompting and respond to the task command only.
6. The instructor gave the task command: "Trace, (name of object 1)," and modeled simultaneously by tracing the

discriminative feature of object 1 on the photograph with her forefinger. The task command was paired with the model so as to establish the association of the response with the task command.

7. The instructor gave the response signal: "Your turn", pointed to the subject and repeated the task command. The response signal and the gestural prompt of pointing to the subject was gradually faded-out.
8. The instructor physically guided the subject's preferred forefinger, saying: "(Name of object 1)", and simultaneously tracing the discriminative feature of object 1 with the subject's forefinger.
9. The subject was reinforced.
10. The instructor repeated Step 6-9 for 5 trials with complete physical guidance (Level 0). At Level 0, the instructor modeled and gave verbal prompts and complete physical guidance by the hand-over-hand method through the tracing of the discriminative feature of the object being taught.
11. If the subject performed the five consecutive trials correctly, the instructor faded complete physical guidance to minimal physical guidance (Level 1).
12. The instructor repeated Step 1-9 for 5 trials with minimal physical guidance (Level 1). At Level 1, the instructor modeled and gave verbal prompts and minimal physical guidance by lightly touching the forefinger of the subject with his thumb and forefinger and physical

guide the subject's finger through the tracing. The instructor stated the task command and paused for 1 sec. before giving minimal physical guidance. This was to permit an anticipation response from the subject, i.e., a motor response to trace and visual a response to attend to the discriminative feature. The subject had to focus on the task command before the prompt was given. The fading of the prompt was done by extending the time between the task command and the prompt.

13. If the subject performed the 5 consecutive trials correctly, the instructor faded the minimal physical guidance (Level 1) to a gestural prompt (Level 2). At Level 2, the instructor gave a gestural prompt by making a motion of tracing the object.
14. The instructor repeated Step 1-9 for 5 trials with the gestural prompt. The instructor stated the task command and paused for 2 secs. before giving the gestural prompt.
15. If the subject performed the 5 consecutive trials correctly, the instructor faded the gestural prompt to no assistance with the task command (Level 3). At Level 3, only the task command was given.
16. The instructor repeated Step 1-9 for 5 trials with no assistance (Level 3). The instructor stated the task command and paused for 3 secs. for the subject to respond.

17. When the subject reached the criterion of tracing the discriminative feature of object 1 (i.e., 5 consecutive correct trials without assistance within 3 secs. of the instructor's task command), the instructor went to the training procedure of object 2 with object 1 on review.
18. If the subject made an incorrect response at any level of guidance or prompting, the instructor said: "No" firmly to the subject and carried out the correction procedure. The instructor continued the same level of guidance or prompting for another 5 trials.

Training Procedure for Object 2

1. The instructor held up the photographs of object 1 and object 2 simultaneously in front of the subject, 24-30 cms. away and at the eye level of the subject.
2. Same as Step 2 in Training Procedure for Object 1.
3. Same as Step 3 in Training Procedure for Object 1.
4 Same as Step 4 in Training Procedure for Object 1.
5. Same as Step 5 in Training Procedure for Object 1.

(The above Steps 2-5 may be faded out if the subject has learned to attend to the photographs without the readiness signal, gestural prompt or physical guidance from the previous training procedure for object 1. In this case, the placement of the photographs was in a faster pace than in the inital training of object 1.)

6. The instructor gave the task command: "Trace (name of object 2)" and modeled simultaneously by tracing the

discriminative feature of object 2 on the photograph with her forefinger.

7. Same as Steps 7-18 in Training Procedure for Object 1. (The fading of the prompting for object 2 was the same as object 1). The instructor randomized the positions of the two photogrpahs for each trial. When randomizing the positions, both photographs were picked up and their positions changed at the same time. Randomization of the positions of the photographs was to avoid any predictable relationship among the stimuli and reduce the subject's chance of learning a misrule such as the photograph on the right is always the correct choice.

19. The discrimination of object 1 was put on a maintenance schedule in which the instructor randomly asked the subject to trace the discriminative feature of object 1 or object 2. Correct responses were reinforced and the correction procedure was delivered for errors. The instructor designated one third of the trials per session to object 1 and two third of the trials to object 2. For example, the random sequence for a 15-trial session (i.e. 5 trials for object 1 and 10 trials for object 2) would be as follows:

2 2 1 2 1 2 1 2 2 1 2 2 2 2 1

20. When the subject reached the criterion of tracing the discriminative feature of object 2 (i.e. 5 consecutive correct trials without assistance, within 3 secs. of the instructor's task command within 1 session), the

instructor introduced the training procedure of object 3 with object 1 and 2 on review.

Training Procedure for Object 3

1. The instructor placed the three photographs of object 1, object 2 and object 3 on the table in front of the subject. The photographs were about 20 cms. away and within the range of vision and reach of the subject. (The readiness signal, gestural prompt and physical guidance for attending to the task had been faded out. If necessary, the instructor may have initially and temporarily used these prompts and guidance to direct the subject to all three photographs).
2. The instructor gave the task command: "Trace (name of object 3)" and modeled simultaneously by tracing the discriminative feature of object 3 on the photograph with her forefinger.
3. Same as Steps 7-18 in Training Procedure for Object 1. (The fading of the prompting for object 3 was the same as object 1). The instructor randomized the positions of the three photographs for each trial.
4. The discrimination of object 1 and 2 was put on maintenance in which the instructor randomly asked the subject to trace the discriminative of feature of object 1 or object 2. Correct responses were reinforced verbally and a correction procedure was delivered for errors. The instructor designated one half of the trials to object 3, one fourth of the trials to object 1

and one fourth of the trials to object 2. For example, a randomized sequence would be as follows:

3 3 3 1 3 2 3 1 2 3 1 3 3 3 2 1 1 2 3 2

5. When the subject reached the criterion of tracing the discriminative feature of object 3, (i.e. 5 consecutive correct trials without assistance, within 3 secs. of the instructor's task command within 1 session), the instructor proceeded to the generalization test.

Generalization tests. A generalization test was given to the subject after he reached criterion in each of the experimental conditions. Another generalization test was given the next day after the criteria of the three conditions had been reached. The third generalization test was given the following day. The fourth generalization test was given the day after the third test. The real objects that were used for the first two generalization tests were the same objects that were shown in the photographs. In the third generalization test, the real objects used were the same as those in the photographs but different in color. The real objects used in the fourth generalization test were the same kind but different in color and shape, etc.

The procedure for the generalization tests was similar to that of the review of the photographs in the instructional training. Three objects instead of photographs were presented simultaneously in the generalization tests. The subject was asked to trace the object requested. Verbal praise was given for each correct

response, such as "Good, you picked the (object requested)." No other reinforcement was used and no assistance was provided. There were five trials for each object and a total of fifteen trials for each generalization test. The order of the objects presented was randomized. The rationale for these generalization tests is described below.

First, the tests were used to evaluate the subject's generalization of the picture concept to the real objects. This evaluation involves the comparison of the effects of near and far generalization. Near generalization refers to the transfer of learning from the concept taught in the initial instruction to new members of concept which share all of the discriminative features and a number of similar nondiscriminative features of the concept. In this study, near generalization involves the transfer of learning from the photographed objects to the same real objects with the same discriminative and nondiscriminative features. Far generalization is the transfer of learning from the acquired concept to new members of the concept that may possess a variety of different values of the discriminative features and a variety of different nondiscriminative features. In the present study, far generalization refers to the transfer of learning from the photographed objects to similar real objects which are different in various nondiscriminative dimensions, such as color and shape, etc. from the photographed objects.

A second use of the generalization tests was to assess the effects of overlearning in different experimental conditions after concept acquisition. Overlearning refers to the continual review or practice of a skill that has already achieved mastery. In this study, each subject was required to continue to review or overlearn the photographed object that he had learned until all nine objects had reached criterion under the three experimental conditions.

Maintenance test. The maintenance test was given 12 days after the fourth generalization test. The purpose of the maintenance test was to determine the subject's ability to maintain the picture concept 12 days after termination of the generalization tests. The maintenance tests were given in the similar way as in the review of the photographs in the instructional training. The number of trials correct in the three maintenance tests were compared within each other.

Chapter V

RESULTS

This study investigated the effects on the rate of concept acquisition, generalization and maintenance in learning to identify nine photographed objects of:(a) using black and white photographs with no background; (b) using color photographs with background and (c) initially using black and white photogrpahs with no background and fading-in half color and half background photographs then full color and full background at the subsequent stages of training. The results of the study are presented in three sections. The first section deals with the effect of the three experimental conditions on the rate of acquisition. The second section is concerned with their effects upon generalization. The third section is related to their effects on maintenance of what the subjects had learned.

In each section, the results are reported first as they relate to the hypotheses tested in the study. Secondly, individual subject data is presented to show the individual difference in rate of acquisition.

Data evaluation. The chi square test of significance (χ^2) was used to evaluate the rate of concept acquisition, the amount of generalization and maintenance for each subject and among the three subjects under the three experimental conditions. Statistical analyses are used occasionally for data analysis in single-subject research

designs, however, their use is an exception rather than a rule (Kadzin, 1982). The rationale for using a statistical analysis in the current study was that visual inspection of the data, the usual method for data evaluation in single-subject research designs, did not reflect clear-cut differences between the three experimental conditions (see Figures 2, 3, 4). Statistical analysis was used to detect any subtle and reliable differences among the three conditions. It also helped to determine whether or not these differences were statistically significant.

The chi square, as used in this study, is a descriptive measure of the magnititude of the discrepancies between the observed and expected frequencies (Ferguson, 1981). There are a few restrictions in using the chi square: (a) the raw data for the chi square must always be in frequencies; (b) all frequencies are independent of each other; (c) all expected frequencies must be at least or 5 or larger (Linton, Gallo & Logan, 1975). A compromise has been made in using the chi square analysis for this study. The number of trials to criterion in acquisition and number of correct responses in both generalization and maintenance tests were treated as independent frequencies.

Acquisition. The rate of acquisition in the study was measured by the number of trials to criterion under the three training conditions.

Figure 2. Comparison of total trials to criterion of Subject 1 in learning the photographed objects under the 3 conditions.

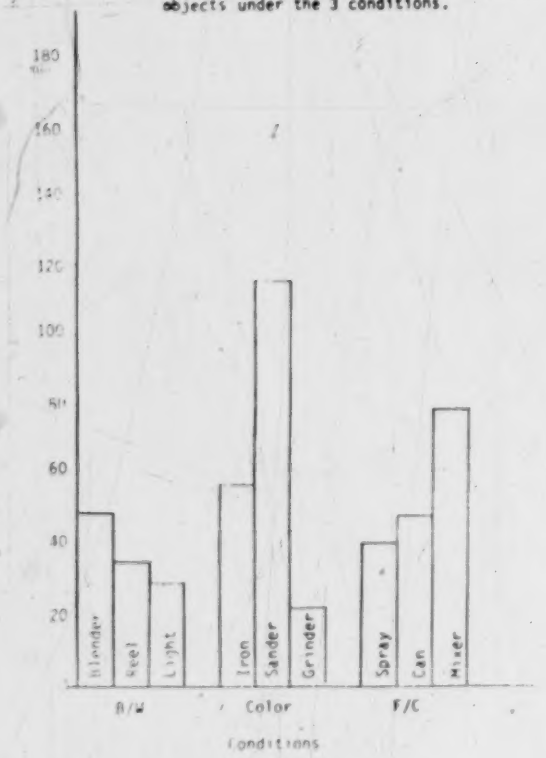


Figure 3. Comparison of total trials to criterion of Subject 2 in learning the photographed objects under the 3 conditions.

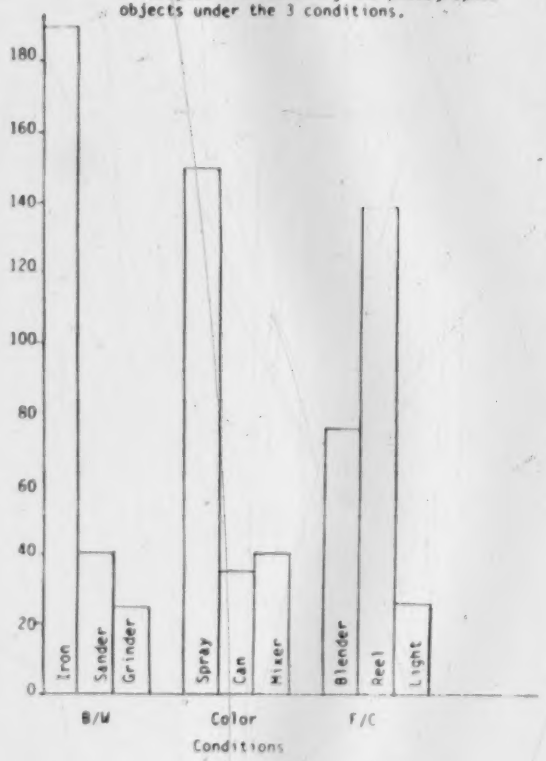
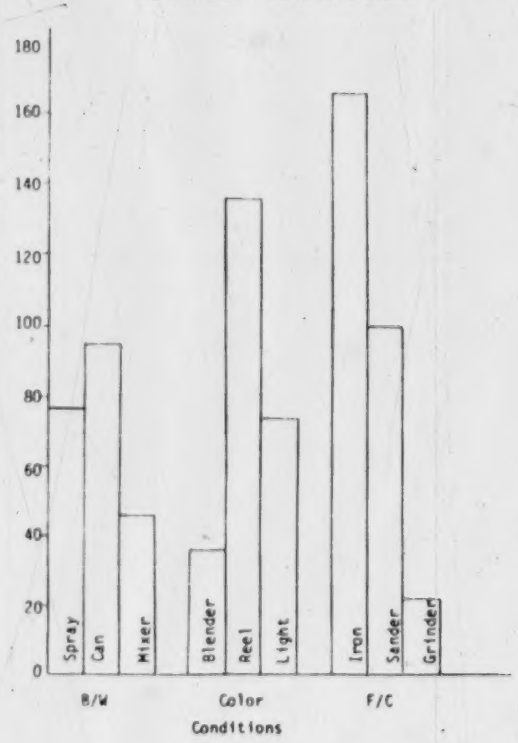


Figure 4. Comparison of total trials to criterion of Subject 3 in learning the photographed objects under the 3 conditions.



Hypothesis Ia. Hypothesis Ia stated that there would be a faster rate of acquisition with fewer trials to criterion under training with black and white photographs with no background having less distraction than the other two conditions.

Table 2 shows the total number of trials to criterion for each subject to learn the nine photographed objects under the three conditions. The overall comparison can be made by comparing the total number of trials to criterion for all subjects under the three conditions.

The total number of trials to criterion for the black and white condition (Table 2) is 575 while the total number of trials to criterion for the color and fading color conditions are 665 and 692 respectively. There is a statistically significant difference in the total number of trials to criterion among the three conditions (χ^2=11.65, df=2, $p > 0.05$).

Since there is a significant difference in the overall comparison of the total number of trials to criterion among the three conditions, further statistical analyses were done on the paired comparisons between black and white and color conditions; color and fading color conditions; and black and white and fading color conditions. The results show that there are significant differences in the total number of trials to criterion between B/W and color conditions (χ^2=20.22, df=2, $p > 0.01$) and between B/W and F/C conditions (χ^2=12.41, df=2, $p > 0.01$). There is no significant

Table 2

Total number of trials to criterion for each subject under different conditions

	Conditions			
Subjects	B/W	Color	F/C	Total
1	115	197	167	479
2	255	225	240	720
3	205	243	285	733
Total	575	665	692	1932

difference between color and F/C conditions (x^2=5.76, df=2, $p > 0.01$). In analysing the individual subject data, both subject 1 and 3 took the least number of trials to crtierion in B/W condition.

Subject 1. As shown in Table 2, subject 1 required a total of 115 trials to criterion in B/W condition while he required the total of 197 and 167 trials to criterion in color and F/C conditions respectively. Statistical analysis of these data reveals a statistically significant difference in the number of trials that subject 1 took to reach criterion in the three conditions (x^2=20.55, df=2, $p > 0.05$). It can therefore be concluded that subject 1 took significantly less trials to criterion in B/W condition than color or F/C conditions. The F/C condition required less trials to criterion than did the color condition. The color condition required most trials to criterion for subject 1.

Subject 2. Subject 2 required the most number of trials to criterion (255) in B/W condition when compared to the number of trials to criterion in color condition (225) and that of F/C condition (240). These data show no statistically significant difference in the number of trials to criterion that subject 2 took to reach criterion in the three conditions (x^2=1.876, df=2, $p > 0.05$).

Subject 3. Subject 3 required the least number of trials to criterion (205) under the B/W condition, compared to 243 and 285 trials to reach criterion in the color condition and F/C condition respectively. These results

show a significant difference among the number of trials that subject 3 took to reach criterion in the three conditions (χ^2=13.106, df=2, $p > 0.05$). Therefore, it can be concluded that subject 3 required significantly less trials to criterion in B/W condition, followed by the color condition. He required the most trials to criterion in the F/C condition.

Hypothesis Ib. Hypothesis Ib stated that there would be a lower rate of acquisition with an increase in number of trials to criterion under training with color and background photographs than training with black and white photographs without background. The rationale is that the color and background are non-discriminative features distracting the subject and therefore, the subject will require more trials to criterion than in the B/W condition and the F/C condition.

As indicated in the overall comparison of the three conditions, the total number of trials to criterion in color condition is more than the B/W condition but less than the F/C condition. Therefore, the group data does not support the hypothesis Ib.

Based on the individual subject data, only subject 1 supported hypothesis Ib. The number of trials to criterion in color condition for subject 1 is 197 which is more than the number of trials to criterion in B/W and F/C conditions. Subject 2 had less trials to criterion in the color condition (225) than in the B/W condition (255). Subject 3

had more trials to criterion in the color condition (243) than in the B/W condition (205) but required more trials than in the F/C condition (285).

Hypothesis Ic. Hypothesis Ic stated that there would be an equal or slower rate of acquisition i.e. more trials to criterion in F/C condition than in B/W condition but that there would be an equal or faster rate of acquisition i.e. less trials to criterion than in the color condition.

The rationale is that with black and white photographs without background used in the initial training in the F/C condition there would be less distraction in the initial training, therefore the F/C condition would require less trials to criterion than in the color condition.

The overall comparison shows that the F/C condition required the higher number of trials to criterion than in the other two conditions. The overall result of the F/C condition does not support hypothesis Ic. The individual subject data reveals that only subject 1 supports hypothesis Ic. Subject 1 required 167 trials to criterion in the F/C condition, which is less trials to criterion than in the color condition (197) but is more trials to criterion than in the B/W condition. Subject 2 had less trials to criterion in the F/C condition (240) than in the B/W condition, but he had more trials to criterion in the F/C condition than the color condition (225). Subject 3 took the highest number of trials to criterion in the F/C condition (285) when compared to the number of trials to

criterion in the other two conditions (B/W=205 and color=243).

Summary

Hypothesis Ia

The overall comparison of the group data and two out of three individual subject data support hypothesis Ia that the B/W condition required significant fewer trials to criterion than in the other two conditions.

Hypothesis Ib

The group data and the data of two out of three subjects are not supportive of hypothesis Ib that there would be a slower rate of acquisition and more trials to criterion in the color condition than in the B/W and F/C conditions.

Hypothesis Ic

Similar to the result of hypothesis Ib, the group data and the data of two out of three subjects that are not supportive of the hypothesis Ic that there would be an equal number or more trials to criterion in the F/C condition than in the B/W condition but equal or less trials to criterion than in the color condition.

Generalization

Generalization tests were administered four times to each subject in the study. The first generalization test was administered immediately after the subject had reached criterion in each of the experimental conditions. The second generalization test was given the next day after the

criteria of the three conditions had been reached. The third generalization test was given in the following day. The fourth generalization test was given the day after the third test.

The real objects that were used for the first two generalization tests were the same objects that are shown in the photographs. In the third generalization test, the real objects used were the same as in the photographs but different in color. The real objects used in the fourth generalization test were the same kind but different in color and shape, etc.

The procedure for the generalization tests was similar to that of the review of the photographs in the instructional training. Three objects were presented simultaneously in the generalization tests. Although the subject was asked to trace the object requested, it was considered a correct response if the subject touched the correct object. Five trials were administered for each object and a total of fifteen trials for each generalization test.

A comparison of the first and second generalization tests was made to assess the effect of overlearning and of near generalization indicating the extent the subjects could generalize from the photographs of the objects to the same real objects.

The comparison of the four generalization tests shows the effect of far and near generalization. The far

generalization refers to the transfer of learning from the picture concept to the similar real objects which differs in various dimensions such as color, shape, etc. from the photographs.

Hypothesis II. Hypothesis II stated that there would be fewer correct responses in the generalization tests in the B/W condition than in the color and F/C conditions. The rationale is that the "simplified" B/W photographs with no background do not fully represent the various different exemplars of the object in the natural environment and therefore, generalization, would be reduced. With color or F/C conditions the photographs more closely resembled real life representation of the objects and therefore there would be more correct generalizations in the two conditions using color than in the B/W condition. The overall comparison for this hypothesis is made by comparing the total number of correct responses during the generalization tests of all subjects in the three conditions. Table 3 shows the total number of correct responses of the three subjects in the four generalization tests under the three conditions. Individual generalization results are shown in Table 4, 5, and 6. The total number of correct responses of the three objects for the B/W condition is 118. The total number of correct responses for the color and F/C conditions are 122 and 101 respectively. The overall comparison of the group data indicates that there was no significant difference in the total number of correct responses of the three subjects

Table 3

Total number of correct responses of the 3 subjects in 4 generalization tests under the 3 conditions

	Total number of correct responses			
Subjects	B/W	COL	F/C	Total
1	48	39	46	133
2	24	37	28	89
3	46	46	27	119
Total	118	122	101	341

Table 4

Generalization results for subject 1: Number of correct responses in 4 generalization tests for the 3 conditions

Condition	Object	Number of correct responses: Generalization tests 1st	2nd	3rd	4th	Total	$\bar{X}$	$\bar{X}$%
B/W	Blender	0	5	4	5	14	3.50	70
	Reel	5	3	4	5	17	4.25	85
	Light	4	5	4	4	17	4.25	85
	Total	9	13	12	14	48	12	
COL	Iron	3	0	4	5	12	3	60
	Sander	3	2	4	5	14	3.50	70
	Grinder	4	1	4	4	13	3.25	65
	Total	10	3	12	14	39	9.75	
F/C	Spray	5	4	5	5	19	4.75	95
	Can	5	4	5	5	19	4.75	95
	Mixer	0	0	4	4	8	2	40
	Total	10	8	14	14	46	11.50	

Table 5

Generalization results for subject 2: Number of correct responses in 4 generalization tests for the 3 conditions

Condition	Object	Number of correct responses: Generalization tests 1st	2nd	3rd	4th	Total	$\bar{X}$	$\bar{X}$%
B/W	Iron	3	3	2	2	10	2.50	50
	Sander	1	2	3	1	7	1.75	35
	Grinder	2	1	3	1	7	1.75	35
	Total	6	6	8	4	24	6	
COL	Spray	1	2	1	1	5	1.25	25
	Can	5	5	4	5	19	4.75	95
	Mixer	5	2	2	4	13	3.25	65
	Total	11	9	7	10	37	9.25	
F/C	Blender	3	1	1	1	6	1.25	30
	Reel	0	4	1	1	6	1.25	30
	Light	5	5	3	3	16	4	80
	Total	8	10	5	5	28	7	

Table 6

Generalization results for subject 3: Number of correct responses in 4 generalization tests for the 3 conditions

Condition	Object	Number of correct responses: Generalization tests 1st	2nd	3rd	4th	Total	$\bar{X}$	$\bar{X}$%
B/W	Spray	5	5	5	4	19	4.75	95
	Can	4	3	5	2	14	3.50	70
	Mixer	4	3	2	4	13	3.25	65
	Total	13	11	12	10	46	11.50	
COL	Blender	5	5	5	5	20	5	100
	Reel	3	3	2	1	9	2.25	45
	Light	5	3	5	4	17	4.25	85
	Total	13	11	12	10	46	11.50	
F/C	Iron	4	2	3	1	10	2.50	50
	Sander	2	1	2	1	6	1.50	30
	Grinder	4	4	2	1	11	2.75	55
	Total	10	7	7	3	27	6.25	

in the four generalization tests under the three conditions (x^2=2.18, df=2, $p > 0.05$). Therefore, the overall result did not support hypothesis II. The result of the individual subject data reveals that there is no significant difference in the total number of correct responses of subject 1 in the four generalization tests under the three conditions (x^2=1, df=2, $p > 0.05$). The same result is found for subject 2 who showed no significant difference in the total number of correct responses in the four generalization tests under the three conditions (x^2=2.98, df=2, $p > 0.05$).

Only the results for subject 3 show a significant difference among the total number of correct responses of the four generalization tests under the three conditions (x^2=6.07, df=2, $p > 0.05$). The major contribution to the statistical difference is the particularly low scores (27) in the F/C condition, as compared to the scores of 46 in both B/W and the color conditions.

In conclusion, the results of the overall comparison of the four generalization tests did not support hypothesis II because there was no significant difference among the results of the tests to prove that the color or the F/C conditions provided better generalization than the B/W condition.

Similar conclusion can be drawn from the result of the individual data. There is no significant difference in the results of the generalization tests in subject 1 and 2 to indicate any effect of the three conditions on

generalization. Only the result of subject 3 showed a significant difference among the four generalization tests. This was not supportive of Hypothesis II because the total score of 40 in the B/W condition is the same that for the color condition but is greater than that of the F/C condition, therefore, the B/W condition resulted in the same amount of generalization as in color condition but better than that of the F/C condition for subject 3.

Maintenance

The maintenance test was administered twelve days after the fourth generalization test was given. This test was dessigned to find out the effect of the three conditions on maintenance. The procedure for the maintenance test was the same as that of the review of the photographs in the instructional training. The three photographs of each condition were presented simultaneously. There were fifteen trials for each condition and five trials for each photographed object. The amount of maintenance was measured by the total number of correct responses made during the maintenance test. The greater the number of correct responses the better the effect of maintenance.

The results are shown in Table 7.

The overall comparison of the group data shows that the three subjects had a total of 40 correct responses under the B/W condition; 41 correct responses under the color condition and 33 correct responses under the F/C condition. The statistical analysis of these group data revealed no

Table 7

Maintenance results: Number of correct responses of the 3 subjects in the maintanence test under the 3 conditions

	Number of correct responses			
Subjects	B/W	COLOR	F/C	Total
1	15	13	12	40
2	15	15	15	45
3	10	13	6	29
Total	40	41	33	114

statistically significant difference among the 3 conditions (χ^2=0.995, df=2, $p > 0.05$). The individual subject data shows that subject 1 scored 15, 13, 12 in B/W, color and F/C conditions respectively. These scores do not show any statistically significant difference in the correct number of responses under the 3 conditions for subject 1 (χ^2=0.34, df=2, $p > 0.05$). Subject 2 has a perfect score regardless of conditions. Subject 3 scored 10, 13, 6 correct responses in B/W, color and F/C conditions respectively. There was no statistically significant difference in these scores under the 3 conditions for subject 3 (χ^2=2.55, df=2, $p > 0.05$).

Other Analyses

Further analysis were done to find out if there were any other variables that may have affected the results of the study. The following varaibles were analysed.

1. The difficulty of learning the 3 groups of objects (i.e. total of 9 objects) regardless of conditions.
2. The order of teaching the first, second and third set of objects that were taught according to the order of teaching.

The overall comparison of the group data which includes the 3 subjects is first presented and followed by paired comparison of the group data on these 2 variables:

Individual object difficulty. An overall comparison of all 9 objects were analysed (Table 8). There is a significant difference (χ^2=15.51, df=2, $p > 0.01$) among the number of trials to criterion required by 3 subjects

Table 8. Total number of trials to criterion required by the 3 subjects to learn the 9 objects.

Subjects	Objects									
	Blender	Reel	Light	Iron	Sander	Grinder	Spray	Can	Mixer	Total
1	49	37	29	57	118	22	40	48	79	479
2	76	139	25	190	40	25	150	35	40	720
3	35	135	73	165	99	21	76	94	35	733
Total	160	311	127	412	257	68	266	177	154	1932
		598			737			597		1932

in learning different objects regardless of conditions. In order of difficulty, iron is most difficult to learn (412), followed by reel (311), spray (266), sander (257), can (177), blender (160), mixer (154), light (127) and grinder (68).

Difficulty of group of objects. The difficulty of learning the 3 groups of object regardless of the conditions was defined by the number of trials to criterion. The object or group of objects that required more trials to criterion is regarded as more difficult to learn when compared with the other groups of objects.

The analysis of the difficulty of learning 3 groups of objects or 9 objects is important because the level of difficulty may affect the results regardless of the conditions. Although the 9 objects were randomly assigned to the 3 groups and subsequently randomly assigned to the 3 conditions in such a way that each subject had different groups of objects under different conditions, there may still be difference in learning the objects that were not controlled. Table 9 shows the total number of trials to criterion required by each subject to learn 3 groups of different objects regardless of the conditions. The overall comparison of the group data shows that the first group of objects (blender/reel/light) required a total of 598 trials to criterion while the second group of objects (iron/sander/grinder) required a total of 737 trials to

Table 9

Total number of trials to criterion required by each subject to learn 3 groups of different objects regardless of conditions

Subjects	Groups of objects (blender, reel, light)	(iron, sander, grinder)	(spray, can, mixer)	Total
1	115	197	167	479
2	240	255	225	720
3	243	285	205	733
Total	598	737	597	1932

criterion and a total of 597 trials for the third group of objects (spray/can/mixer).

The statistical analysis of these data indicates that there was a significant difference in the total number of trials to criterion among the 3 groups of objects (χ^2=20.14, df=2, $p > 0.05$). A paired comparison of the total number of trials to criterion in the first and second groups of objects shows a statistically significant difference between the groups (χ^2=10.98, df=2, $p > 0.01$). Similar result were found in the comparison of the first and third groups of objects (χ^2=13.31, df=2, $p > 0.01$). There was no significant difference in the total number of trials to criterion in the second and third groups of objects (χ^2=1.87, df=2, $p > 0.01$). Thus, it is inferred that the first group of objects is less difficult than the second group but more difficult than the third group.

The effect of the order of teaching. The effect of the order of teaching was measured by the total number of trials to criterion to learn the first, second and third set of objects according to the order of teaching, regardless of the conditions and the subjects. As indicated in Table 10, the total number of trials to criterion to learn the first set of objects (blender, iron, spray) according to the order of teaching was 838 trials to criterion. The second set of objects (reel, sander, can) according to the order of teaching was 745

Table 10

Total number of trials to criterion required by each subject according to the order of teaching (i.e., 1st, 2nd, 3rd order of objects taught) regardless of conditions

Subjects	Order of teaching (blender, iron, spray)	(reel, sander, can)	(light, grinder mixer)	Total
1	146	203	130	479
2	416	214	90	720
3	276	328	129	733
Total	838	745	349	1932

trials. The third set of objects (light, grinder, mixer) required 347 trials to criterion. There is a statistically significant difference in the total number of trials that the 3 subjects took to reach criterion according to the order of teaching (χ^2=209.41, df=2, $p > 0.05$). A paired comparison of the total number of trials to criterion in the first and second sets of objects according to the order of teaching shows that there is a significant difference between the 2 sets of objects (χ^2=73.33, df=2, $p > 0.01$). Similar results are found in the second and third sets of objects (χ^2=11.39, df=2, $p > 0.01$) and the first and third sets of objects (χ^2=75.72, df=2, $p > 0.01$). These results indicate that the first set of objects according to the order of teaching required significantly greater number of trials to criterion than the second and third sets of objects.

Multiple Regression Analysis

A multiple regression analysis was performed to analyse the relationship between the number of trials to criterion and each of the four predictors: conditions, the difficulty of objects, order of teaching and the subjects. The results of this analysis are summarized in Table 11.

The results show that the difficulty of objects and the order of teaching each accounts for 24% of the total variance. The effect of the conditions and subjects were almost negligible.

Table 11

Correlations between number of trials and each of the four variables: Conditions, objects, order of teaching and subjects.

	Residual Sum of Square	R^2	$R^2_{Full} - R^2_{Model}$
Full model	26264.44	.5738	
Full model less conditions	27098.44	.5603	.0135
Full model less objects	41257.11	.3305	.2433
Full model less order	41249.11	.3306	.2432
Full model less subjects	30811.33	.5000	.0738

Chapter VI

DISCUSSION

Acquisition

The results of this study indicate that pictorial instruction using black and white photographs without background required significantly less trials to criterion than color photographs with full background or black and white photographs in which half color and half background is faded in followed by full color and a full background. These results support the contention that increasing the discriminative features and decreasing the nondiscriminiative features of photographs minimizes distraction, and enhances concept acquisition.

These results also further support the research evidence (Chute, 1979, Meador, 1984) that color acting as a nondiscriminative feature, as in this study, does not improve discrimination learning. The irrelevant details in the background, acting as nondiscriminative features also interfered with discrimination learning. These results support Silverman's (1980) argument that the level of complexity (i.e. the background) of pictures should be kept to a minimum.

Generalization

The generalization results showed no significant difference resulting from the three types of photographs. Black and white photographs, with nondiscriminative features

removed, were just as effective in enhancing generalization as were the other types of photographs. This finding does not support the results of Modigliani (1971) that when the nondiscriminative features are not introduced, generalization of learning is greatly reduced. Fading-in color and background gradually in the photographs during the learning stage did not improve generalization. This finding does not confirm Hillyard's (1979) results that holding the number of discriminative features constant, while increasing the number of nondiscriminative characteristics resulted in an increase in generalization to the new examples.

It is important to note that the three subjects all showed various degrees of generalization from photographs to real objects, regardless of the treatment conditions. Subject 1 had mean percentages of correct responses that range from 40% to 95% (Table 4). Subject 2 had mean percentages of correct responses that range from 25% to 80% (Table 5). Subject 3 had mean percentages of correct responses from 30% to 95% (Table 6). Since there was no significant statistical difference in generalization among the three conditions and since no training was provided for the transfer of learning from the photographs to the real objects, this shows that generalization occurred without specific generalization training. One possible explanation for the transfer of learning from photographs to real objects is that tracing the discriminative features of the photographed objects may have directed the subjects'

attention to the discriminative features of the photographed objects regardless of the nondiscriminative features. Once they learned to identify the discriminative features of the photographed objects, they could generalize the discriminative features to that of the real objects. This strategy is similar to the "programming common stimuli" strategy that was discussed by Stokes and Baer (1977). This strategy involves presentation of common and salient stimuli in both training and generalization settings to assist transfer of stimulus control. Instead of presenting only the common and salient stimuli, the instructor should teach the learner to identify the discriminative features of these stimuli when applied to concept learning. This confirms Stokes and Baer's (1977) conviction that generalization does not occur without programming.

With the tracing technique, the learner's attention was directed to focus on the discriminative features. This supports Zeaman and House's (1963) attention theory that mentally handicapped child must be directed to attend to the relevant dimension in order to make the necessary discrimination(s). The use of tracing as an attention gaining and generalization training strategy requires further study.

Photographs

The evidence of generalization in the present study has proved that highly representative black and white photographs are viable alternative to using real objects for

concept learning. This study also showed that controlling the nondiscriminative features presented in the black and white photographs enhances the rate of acquisition. Only the use of photographs or pictures could allow the instructor to manipulate such variables in concept learning. The demonstration of transfer of learning from photograph to real objects by the dependent handicapped (severely handicapped) subjects in the present study seems to support research findings that picture perception does not depend on age, education or level of intelligence (e.g., Daehler, Perlmutter & Meyers, 1976; Gibson, 1969; Kennedy, 1974). As indicated in the present study, photographs may be made more effective with the combination of the tracing technique and discriminative feature learning.

Differences in difficulty of learning among objects

As illustrated by the multiple regression analysis, there are two variables that affected the results of the study. The first one is the differences of learning difficulty among objects and the other is the order effect of teaching the objects. The present study found that the iron required the most trials to criterion, followed by the reel, spray, sander, can, mixer, blender, light, and the grinder which required the least trials to criterion. Although this study attempted to control for differences in difficulty among objects by randomization, i.e., the objects were randomly assigned to the three experimental conditions,

differences in difficulty of learning among the objects were still evident.

Through casual observation, the experimenter found that all subjects had difficulty in discriminating the iron from the sander during initial learning regardless of the treatment conditions. A possible explanation for the difficulty was due to the physical similarity of the two objects. Both the iron and sander shared some similar features, such as the base, the handle and the cord. These commonalities may have initially confused the subjects before the discriminative features of each object took over stimulus control. There was relative ease in learning the grinder (according to the number of trials to criterion). Table 9 reveals that the three subjects took a total of 68 trials to learn the grinder, while they took 412 and 257 trials to learn the iron and the sander respectively. This result may contribute to the learning of multidimensional object (junk) discrimination (Zeaman & House, 1963). According to Zeaman and House's (1963) theory, handicapped students learn faster when the discriminant objects differed in numerous and unidentified dimensions (such as the grinder as compared to the iron and/or the sander in the study) than when objects with only two relevant dimensions were involved (such as iron and sander).

The order effect of teaching the objects

The order effect of teaching the objects is referred to the order of object that was taught, i.e., first, second or

third order. This study attempted to control the effect of order in which the objects were taught by randomly selecting the order of teaching each group of objects. However, the order of objects being taught still affected the results of the study. It was found that the objects that were taught first, regardless of the conditions, required significantly more trials to criterion than the objects that were taught second or third in order.

This finding may be explained by the tracing technique that was used as the physical response to the identification of photographed objects. When the subjects were learning the first object in the teaching sequence, they were also learning to trace at the same time. Although all subjects began at the same level of minimal physical assistance in tracing, more trials may have been required for learning the response. Once they become proficient in tracing, they might have required less trials to learn the second or third objects. This flaw could be corrected by pretraining the tracing response before the treatment begins.

Educational implications

This study has shown that black and white photographs without background were more effective than color photographs without full background in improving concept acquisition. When preparing photographs, teachers should consider increasing the salience of the discriminative features and reducing the nondiscriminative features in the photographs. Some of the methods that were employed in this

study to develop the photographs can be used as a reference in reducing the nondiscriminative features of the object in the photographs. The object should be photographed in an angle that would bring out the discriminative feature of the object and should be in a natural angle of observation. Glares, reflections from light sources and extraneous shadows on the objects and complex backgrounds should be removed from the photographs.

A highly representative photograph is a viable alternative to real objects for concept learning. Besides using high-quality photographs, it is essential to develop strategies for discriminative feature training for both acquisition and generalization. Teaching the tracing strategy used in this study may be considered as an alternative to "pointing" which is a popular motor response in discriminative learning. In learning situations where pointing is used as the response to the discrimination task, some learners tend to point without paying attention to the stimuli. The advantage of using tracing is that it directs the learner's attention to the discriminative feature of the stimuli. The learner has to remain attentive in tracing the discriminative feature before he can make a correct response. Tracing may avoid the problem of some handicapped learners who attend to the physical properties (rectangular edge, flat surface) of the photographs (Dixon, 1981). A drawback of using tracing for severely handicapped is the physical consideration of the learner's fine motor ability.

The learner is required to have the fine motor finger skill and good eye-hand coordination. This may place some limitations on using tracing for the severely handicapped who usually have some physical disabilities.

The strategy for discriminative feature training should include the identification of discriminative features of the stimuli to be taught. The instructor should decide before instruction, what discriminative features in the stimuli will best facilitate the learner's discrimination among the various stimuli being presented.

The effect of the difference in the difficulty of learning among the objects in this study has significant implications for material selection for instructional purposes. In selecting stimuli for discrimination learning, teachers should consider the similarity of features in the stimuli to be selected. In order to facilitate discrimination in the initial training, the discriminative features of the two stimuli should be as dissimilar from each other as possible. This is to avoid the confusion that the learner may have in discriminating among them. Then, in subsequent learning, more stimuli with similar discriminative features can be faded-in to facilitate finer discrimination.

Further Research

The tracing strategy is a relatively new technique. Its values as an attention focusing device in discrimination learning for the severely handicapped requires further

investigation. The color photographs with full background and the fade-in technique failed to enhance generalization in the present study. Further research is needed to assess their effectiveness in improving genralization.

As indicated earlier, high quality photographs were effective in transfer of learning to the real objects with the combination of tracing technique and discriminative feature training. Further investigation, as suggested by Donnellan and Mirenda (1983) on the interactive effects of different instructional components is necessary. This may confirm that generalization requires a combination of strategies to be effective.

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